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TRANSURETHRAL REMOVAL OF PAPILLOMA OF THE BLADDER

WILLIAM J. ENGEL, M. D.

Several years ago, a chance experience focused my attention on the possibilities of a new method for intravesical excision of papillary tumors of the bladder. A patient who was to have a transurethral resection for prostatic hypertrophy also had a small papilloma of the bladder. The tumor was approximately one centimeter in diameter and the pedicle was attached just above the right ureteral orifice. It occurred to me that this growth could be removed with the resectoscope at the time of operation on the prostate gland. Hence, when the prostatic resection was completed, the papilloma was engaged in the loop of the instrument. Two or three bites removed the tumor cleanly down to the bladder mucosa, and the base then was coagulated thoroughly. Cystoscopic examination several months later demonstrated that the growth had been removed completely, and there was no evidence of recurrence. These observations stimulated my interest in this method of treatment and, as a consequence, smaller pedunculated tumors of the bladder have been excised intravesically in this fashion in twenty-six instances during the last three years. A technic has been evolved which is applicable to tumors as large as 5 centimeters in diameter or, roughly, the size of a golf ball.

SYMPTOMS

It is pertinent to this discussion to recall the fact that the cardinal symptom of papilloma of the bladder is blood in the urine. This usually appears spontaneously "out of the clear sky" and is seldom attended by burning, frequency, pain, or any other urinary symptoms. It may last only a day or even less and disappear with the same abruptness which marked its appearance. This short duration of hematuria has, unfortunately in many cases, misled both patients and physicians to believe it was of no significance. Recurrent attacks of bleeding are the rule and often each succeeding episode is more severe. It is not uncommon, however, for a year or more to elapse between the first and second appearance of hematuria which emphasizes the importance of investigating the initial warning. Occasionally one sees alarming hemorrhages from these tumors and these may be so severe that a blood transfusion must be given. The amount of bleeding is no index of the size of the tumor as the worst hemorrhage I have seen came from a small papilloma.

Thus hematuria is the only symptom of papilloma of the bladder. One should not wait for the appearance of burning, frequency, tenesmus, etc., for these symptoms in a patient with a bladder tumor usually indicate malignancy and a more unfavorable prognosis for the patient.

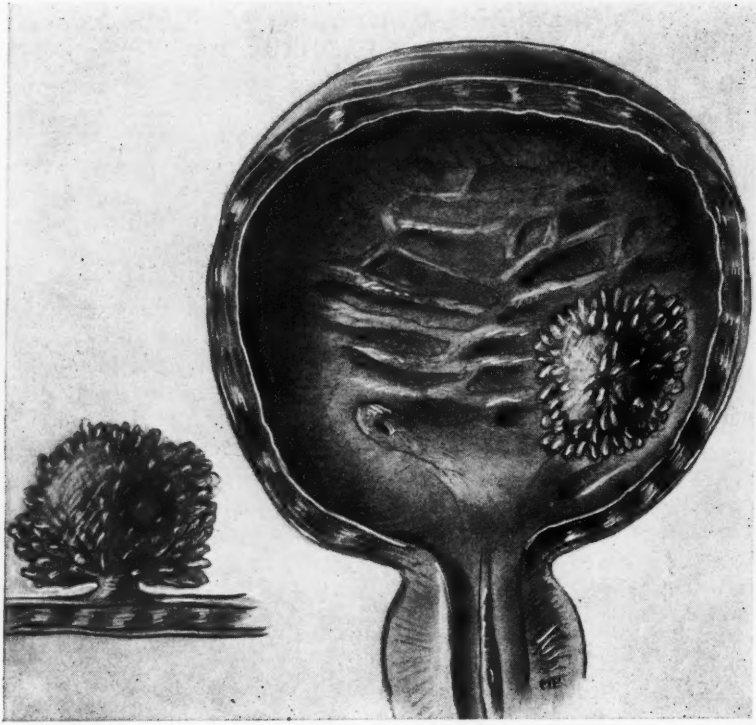

FIGURE 1: Drawing showing pedunculated, soft villous papilloma which is the type suitable for transurethral resection.

CLASSIFICATION OF PAPILLARY TUMORS OF THE BLADDER

Papillary tumors of the bladder constitute about 90 per cent of all bladder tumors. Strictly defined, they include those epithelial tumors which are elevated and project into the lumen of the bladder. They stand in sharp contrast clinically to the infiltrating tumors which invade the bladder wall and grow by surface extension.

Two types of papillary tumors are recognized cystoscopically. The first is the pedunculated, soft, villous papilloma which may be benign or may show histologic evidence of malignancy. (Fig. 1) These papillomata may be single or multiple and may vary greatly in size, which is an important consideration in the selection of the operation.

The second type of papillary growth is the sessile, broad-based, more solid carcinoma. (Fig. 2) In most instances, this is a single tumor, although it may occur in association with other papillomata. It invades

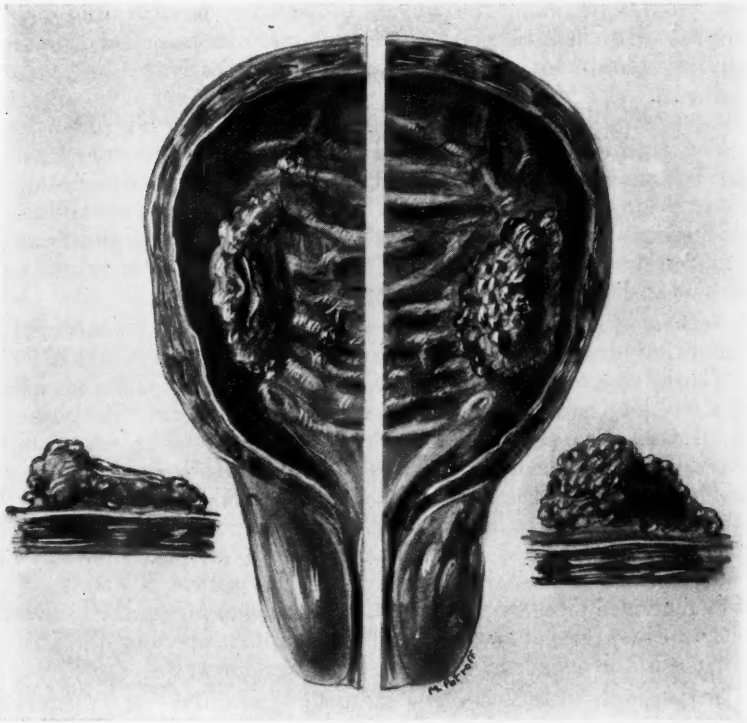

FIGURE 2: Drawing showing sessile, broad-based, more solid carcinoma. This type is not suitable for resection.

the bladder and may exhibit a sloughing, ulcerating surface covered with calcareous material. From the standpoint of treatment, this type of tumor requires more radical measures which are not within the scope of this discussion.

The papilloma must always be regarded as a potentially cancerous growth. Buerger[1] has estimated that from 30 to 35 per cent of all papillomata become malignant. This emphasizes the importance of the complete destruction of these neoplasms when they are first discovered. Even then the problem of recurrence must be dealt with, for, in many instances, a papillomatous growth reappears even though the original tumor has been completely destroyed. In such a case the lesion must be regarded as a new tumor, rather than as a recurrence of the original growth. Obviously the same factors, whatever they may be, which produced the first tumor still exist, and the patient presents a potential problem as long as he lives and retains his bladder. We have the record of one patient from whom a large papilloma of the bladder

was removed in 1913. He returned to the Clinic in 1934, after a free interval of twenty-one years, with what must be classified as a new papillomatous tumor. This was resected intravesically.

The Treatment of the Pedunculated Papillomata

The operation herein described is applicable to the treatment of papillomata with well defined pedicles, regardless of whether the tumor is benign or malignant. Its only limitation is the size of the tumor, although my experience leads me to the opinion that any growth up to 5 cm. in diameter is suitable. If the diameter is greater than 5 cm., the tumor should be removed by suprapubic cystotomy.

Technic of the Intravesical Operation: The technic of the intravesical removal of bladder tumors is similar to that of prostatic resection. The McCarthy resectoscope is employed. This instrument has the advantage of a free loop which cuts with either a to or fro motion. The objective in all cases is to expose the pedicle of the growth which may then be excised flush with the bladder mucosa. In the case of small papillomata, this may frequently be accomplished with a single stroke, whereas the larger tumors have a bushy overhanging margin which must first be removed before the pedicle can be exposed. In such cases the superior and anterior surfaces are cut away until the pedicle is visible. This is then divided piece by piece by pushing the loop forward. To blindly place the loop beyond the tumor and cut toward the operator is hazardous because of the danger of perforating the bladder wall.

Surprisingly little bleeding is encountered ordinarily and there is no difficulty in controlling this with electrocoagulation. Complete coagulation of the surface before the resection is begun has been a great help in some instances when the tumor was fairly large. Once the pedicle is exposed, thorough coagulation usually renders the operation bloodless. It is essential that bleeding be controlled at all times; otherwise the surgeon is confused because of inadequate vision and clots which obscure the boundaries of the tumor.

When the growth has been removed, the base should then be coagulated thoroughly, including an area wide enough to insure destruction of all involved mucosa. Radium has not been implanted in any of the cases in this series and it is not necessary if the tumor has been completely removed and the base adequately treated.

Advantages of the Intravesical Operation: Previously, fulguration was the only intravesical method of treating papillomata of the bladder. This entailed repeated cystoscopic instrumentation and, in many instances, it failed to completely control the growth of the tumor or recurrences. With the resectoscope, it now is possible to remove the entire tumor completely and thoroughly at one operation. This constitutes an obvious advantage.

The intravesical operation has several other advantages: (1) The operative risk is minimized and no deaths have occurred in this series of patients; (2) the period of hospitalization is markedly reduced—the average stay in the hospital for this group of patients was 3.7 days, with a minimum of one day and a maximum of twelve days; (3) tumors for which this operation is suitable can be removed more completely and thoroughly under cystoscopic vision in the intact, distended bladder than with the unaided eye in an opened collapsed bladder; (4) there is less chance of overlooking small secondary growths in the bladder and the occasional recurrence or implant in the prostatic urethra does not escape detection which might easily occur when the bladder is opened and viewed suprapubically; (5) the danger of accidental implantation of tumor cells in the wound has been eliminated by avoiding suprapubic operation.

Results of Transurethral Resection

The results of this operation have been most gratifying and have definitely established the fact that it is possible to completely destroy these tumors by this method. Twenty-one of the twenty-six patients have been carefully followed from six months to three years and are known to be well and have no recurrence. Four patients have had small recurrences treated but they are now well and cystoscopic examination shows a normal bladder. One patient has not returned for follow-up examination. In following these patients we do not rely upon symptoms alone but always make a cystoscopic examination at each return visit. This is essential in order to detect early recurrences when they are small and hence easily destroyed.

There have been no operative deaths and no noteworthy complications. Postoperative hemorrhage has occurred in only a single instance and this appeared about twelve days following resection for multiple papillomata. It was relatively mild and only two days of catheter drainage were required to clear it up. One patient's convalescence was delayed by a postoperative pyelitis which responded promptly to appropriate treatment. The only remaining complication was a cystitis which occurred in a woman who had a large cystocele.

Follow-up Management of Patients with Papillary Tumors

These tumors have a marked tendency to recur; hence, close observation after operation is necessary. After either intravesical or suprapubic removal, the surgeon has only begun his treatment of the patient. He must give careful explanations regarding the tendency of these tumors to recur asymptomatically, and he must impress upon the patient that periodic cystoscopic examination is essential. He is even justified in the threat that cancer will be the result if this warning is ignored. If recur-

rent tumors can be discovered when they are small and still benign, their removal is an easy task, but if they are discovered late when they are large, multiple, or malignant, the outlook may be quite different. It is not sufficient simply to instruct a patient to return at a definite time, but he must be given an adequate explanation for doing so, because the patient who is experiencing no difficulty seldom reports for observation. Experience has proved that greater coöperation can be gained by an intelligent, sympathetic explanation of the problem, even to the point of a short discussion of the pathology of these tumors in lay terms. The patient with a bladder tumor must be educated to understand his problem. Granting that the patient returns for periodic examination, recurrent tumors may be removed by the transurethral method, or minute growths may be destroyed by simple fulguration without anesthesia. Should recurrence be rapid or multiple or should general papillomatosis develop, the lesion must be considered as of the same degree of malignancy as the sessile, broad-based type of papilloma. In these cases more radical measures must be instituted.

Summary

Before the method of treatment can be determined, a clear distinction must be made between the pedunculated, papillomatous tumors and the sessile, broad-based papillary carcinoma.

All primary, pedunculated, papillomatous tumors, single or multiple, which are, roughly, 5 centimeters or less in diameter, can be removed completely at a single operation by intravesical excision with the McCarthy resectoscope. Larger tumors of this type should be excised by suprapubic cystotomy.

Regardless of the method employed, the patient should report at frequent intervals for the first year and annually or semi-annually thereafter for cystoscopic examination in order that possible recurrent growths may be detected and destroyed.

References

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2. Graham, Allen: Tumors of the bladder, J. Urol., 33:565-569, (June) 1935.

CONDYLAR FRACTURES OF THE HUMERUS

JAMES A. DICKSON, M. D.
AND
CLIFFORD L. GRAVES, M. D.

Most fractures of the lower humerus can be classified into three main groups: the supracondylar, the condylar, and the epicondylar (Fig. 1); other varieties such as the diacondylar and the T or Y fractures are much less common. Only condylar fractures* will be discussed here because their treatment involves several peculiar problems which are not always handled to the best advantage of the patient. To understand these problems one must have a clear conception of the

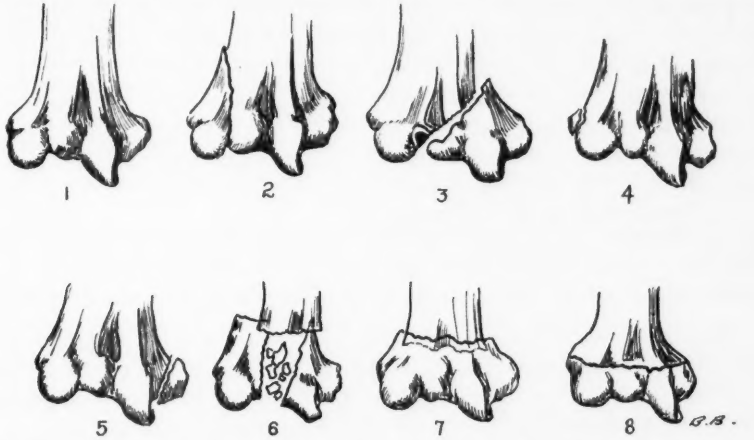

FIGURE 1: Schematic representation of various fractures of the lower humerus. 1. Normal contour. 2. Fracture of the external condyle. 3. Fracture of the internal condyle. 4. Fracture of the external epicondyle. 5. Fracture of the internal epicondyle. 6. Intercondyloid or T fracture. 7. Supracondylar fracture. 8. Diacondylar fracture. (After Wilson and Cochran, Fractures and Dislocations).

difference between a supracondylar and a condylar fracture and the anatomy and epiphyseal development of the lower humerus.

In the usual supracondylar fracture, the lower fragment is pulled up and back by the triceps muscle, but it is not tilted significantly because the attached muscles (the flexors to the internal condyle and the extensors to the external condyle) pull evenly and symmetrically. Consequently, by manipulating the forearm one can gain satisfactory control over the fragment, disengage it, and accomplish reduction by a fairly simple, well-standardized maneuver.

*In this paper epicondylar fractures are included in the term condylar fractures.

An entirely different situation exists when a single condyle is broken. Such a condyle forms a small triangular fragment to which is attached a single set of powerful muscles which produce a displacement that is in many cases characteristic. The condyle is not only pulled down but also twisted on itself so that its fractured surface faces outward instead of inward. This is not always apparent on casual inspection of the roentgenogram, but careful "three-dimensional" reconstruction will reveal it with great regularity (Figs. 4,C and 5,C). From a study of figures 4,A and 5,A, it is obvious that any manipulation of the forearm under such circumstances only increases the malposition, and even if one could push the fragment back toward the humerus it would still be impossible to correct the rotation that has occurred. When the fragment has been displaced in this manner, *proper reduction can be accomplished only by open operation.*

FIGURE 2: Diagram of epiphyses of lower humerus at the end of the growth period. Front view, left humerus. The figures in the shaded epiphyses indicate the average time of appearance; the figures attached to arrows indicate the average time of fusion. "No fusion" indicates that the epiphyses here do not fuse with each other, but join the shaft independently. (After Baumann, Beitr. z. klin. Chir., 146:1, 1929).

This difference between supracondylar and condylar fractures becomes still more important when the development of the elbow is considered. Since these fractures occur much more commonly in children, they affect growing epiphyses that are very sensitive to injury.

In the supracondylar fracture, all the epiphyses are detached *en masse* and do not suffer any relative change in position. If a subsequent retardation of growth should occur (which would be unusual) all the epiphyses would share equally in the process. If the forearm is properly aligned at the time of reduction, there is no reason to fear subsequent deformity, and the clinical results bear out this statement.

On the other hand, if the displaced single condyle is not accurately reduced, a most unfortunate chain of events ensues. The condyle in its vicious position cannot unite; it therefore deprives one-half the articular surface of the humerus of normal growth, with the result that the uninjured, expanding epiphysis gradually pushes the elbow into a varus or valgus position. Anyone who has followed a patient with such an elbow and seen the deformity progress from bad to worse will agree that nothing but an immediate, open reduction suffices. The operation should be done through a generous incision giving free access to the

fractured condyle. Even with thorough exposure one may have difficulty in maneuvering the fragment into place. The procedure may be compared to the fitting together of a jigsaw puzzle or to an intricate bit of cabinetmaking. The point we wish to make is that condylar fractures with gross displacement are major surgical problems whose solution should not be undertaken without due respect for the difficulties involved.

Anatomy: The lower third of the humeral shaft is considerably broadened and flattened and curved slightly forward. The supracondylar ridges, which are the thin lateral borders, flare out sharply below to form the condyles. Each ridge terminates in a small projecting knob, the epicondyle. The internal one which is much the more prominent of the two gives attachment to the pronator teres and to a common tendon of origin of some of the flexor muscles of the forearm. The external condyle gives attachment to the supinator and to a common tendon of origin of some of the extensor muscles of the forearm. The articular surface consists of two parts of unequal size, separated by a median ridge. The larger and internal one is the trochlea and articulates with the sigmoid cavity of the ulna. The smaller and external one, nearly spherical, is the capitellum and articulates with the head of the radius. Above the trochlea on the posterior surface is the large olecranon fossa which receives the tip of the olecranon process when the elbow is completely extended. The humero-ulnar articulation is a pure hinge joint which permits only flexion and extension; the humeroradial articulation is a gliding joint which allows the radius to accompany the ulna in flexion and extension; the superior radio-ulnar articulation is a swivel joint which is responsible for the rotary motions of the head of the radius. These three articulations have a single capsule and together form the elbow joint.

At birth, the lower end of the humerus is cartilaginous. Ossification takes place from four separate centers: the capitellum, the internal epicondyle, the trochlea, and, occasionally, the external epicondyle. There is considerable variation in the ages at which these centers first become visible roentgenographically; therefore, the following figures are only approximate: At the end of the second year, ossification begins in the capitellum and extends medially to form the chief part of the articular end of the bone; the center for the medial part (trochlea) appears about the age of twelve. Ossification begins in the internal epicondyle about the fifth year and in the external epicondyle about the thirteenth year. The capitellar and trochlear centers unite at about the thirteenth year, and the external epicondyle joins them soon afterward. These three epiphyses, in one mass, then fuse with the shaft at about sixteen years, but the medial epicondyle usually remains separate for at least another year. (Fig. 2.)

Roentgen Examination: Since the lower humerus has four separate epiphyses, every one with its own wide range of normal variations, the appearance of the roentgenogram may be very misleading. Epiphyses may easily be mistaken for fragments and epiphyseal lines for fracture lines. Moreover, if the roentgenograms are not taken in *exactly* anteroposterior and lateral directions, much distortion occurs in the films. This causes still more confusion of the shadows. *We therefore always make control observations on the sound side.* With roentgenograms made in this manner, certain constant relationships between the epiphyseal centers and the humeral shaft can be observed, and any gross alterations determined with the aid of the following lines and measurements:

1. In the lateral view, with the elbow flexed to a right angle, a line passed along the long axis of the shaft midway between its anterior and posterior borders passes behind the posterior border of the capitellum in children up to the age of about nine, and the line of the anterior limit of the shaft has at least one-half the capitellum in front of it (Fig. 3, A). After the age of nine, the capitellum gradually recedes and the line bisecting the shaft has approximately two-thirds of the capitellum anterior to it (Fig. 3, B).

2. A line at right angles to the base of the capitellum and bisecting it, forms an angle of about 130 degrees with the line of the long axis of the shaft (Fig. 3, C).

3. When the forearm is extended and fully supinated, the long axis of the humerus forms an angle of about 170 degrees with the long axis of the ulna (carrying angle) (Fig. 3, D).

4. The epiphysis of the internal condyle is in close proximity to the internal oblique line of the shaft (Fig. 3, E).

5. In the anteroposterior view, a line connecting the two epicondylar epiphyses (epicondylar line) is at right angles to the longitudinal axis of the shaft and is approximately bisected by it (Fig. 3, F). Since the external epicondyle does not show before the thirteenth year, a condylar line may be used instead of the epicondylar line, the condylar line connecting the points where condyles and epicondyles merge.

Incidence: Figure 1 indicates the nomenclature used with fractures of the lower end of the humerus and is self-explanatory. As has been said, most of the fractures of the lower humerus occur during the growth period, that is, in the first and second decades, especially the first. The reason is that the humerus is a much weaker structure in the child than in the adult in whom dislocation of the elbow is more likely to occur. The left elbow is fractured more commonly than the right, probably because the left arm is used for protection while the right hand holds

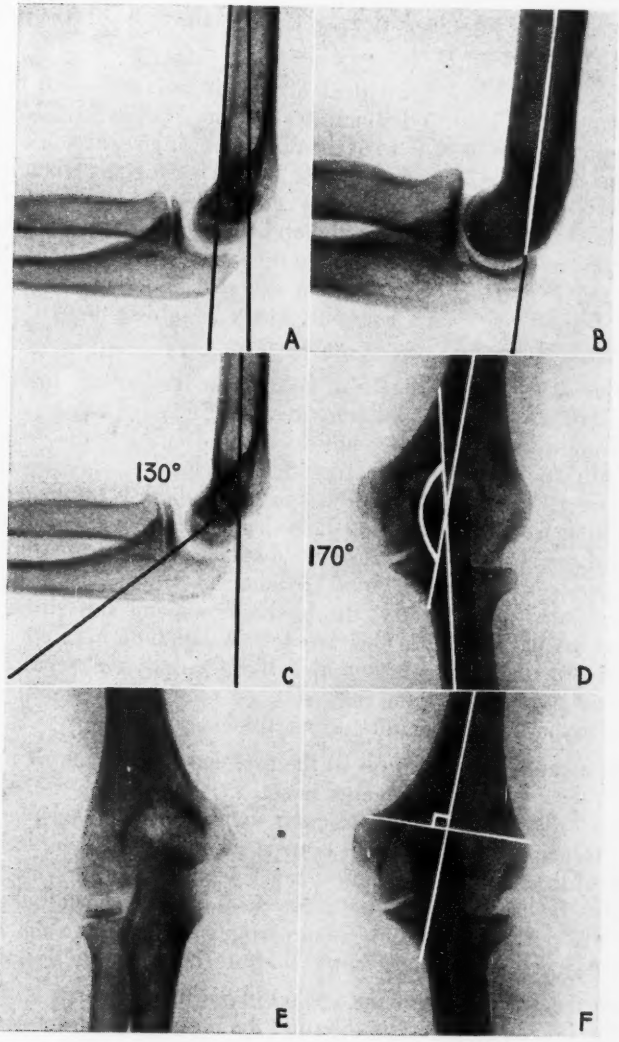

FIGURE 3: Lines and angles of normal elbow. See text.

on to objects. As would be expected, boys outnumber girls in most of the reported series.

The proportion of supracondylar to condylar fractures varies somewhat, but generally the former are the more common. Of the condyles, the external one is fractured more frequently than the internal. In the

epicondyles, this relationship is reversed, fracture of the external epicondyle being quite rare.

Signs: Invariably a great deal of swelling occurs about the joint which makes it difficult to distinguish the bony landmarks. Normally, the two epicondyles and the tip of the olecranon process are on a straight line when the elbow is extended, and form an isosceles triangle when the elbow is flexed. This relationship is disturbed in condylar fractures. There will also be abnormal lateral mobility of the forearm and crepitus. Movements of pronation and supination are painful, depending on which condyle is fractured. For an exact diagnosis, roentgenograms are indispensable so that it is not necessary to subject the patient to an exhaustive and painful clinical examination.

Treatment: The importance of accurate reduction has already been emphasized. Not all condylar fractures require an open operation, however. To outline the operative indications and evaluate the end results, it is helpful to divide these fractures into three classes according to the displacement that occurs: (1) those in which there is no displacement, (2) those in which there is only lateral displacement without rotation, and (3) those in which there is severe displacement with rotation. These three types occur with about equal frequency. It is the last group which is responsible for unsightly, disabled elbows and has provided the incentive for the writing of this article. We include here not only the condylar fractures proper, but also those epiphyseal separations in which any part of the humerus itself, no matter how small, remains attached to the fractured capitellum or trochlea.

When a condylar fracture is of the first class, the humerus is merely fissured, the periosteum remains intact, the blood supply of the fragment is not disturbed, and the articular surface suffers no change in contour. Accordingly, these patients need no more than simple immobilization of the arm in a sling for a few weeks. After that, motion may gradually be resumed. Subsequent disability is short and the end results are perfect. The only roentgenographic evidence that remains indefinitely is a small notch on the shaft at the top of the fracture line.

When the fracture is of the second class, the fragment is displaced laterally, i.e., away from the joint but the periosteum is not completely stripped and rotation is therefore prevented. It is usually unnecessary to attempt reposition of the fragment and, in fact, it would be difficult to do so by manipulation alone. The fragment still has its blood supply, the contour of the articular surface is only slightly altered and union invariably takes place provided the arm is immobilized in flexion for a few weeks. The results are usually good although occasionally some limitation of motion persists for a long time. Subsequent changes in the roentgenogram are characteristic and can always be found if looked for.

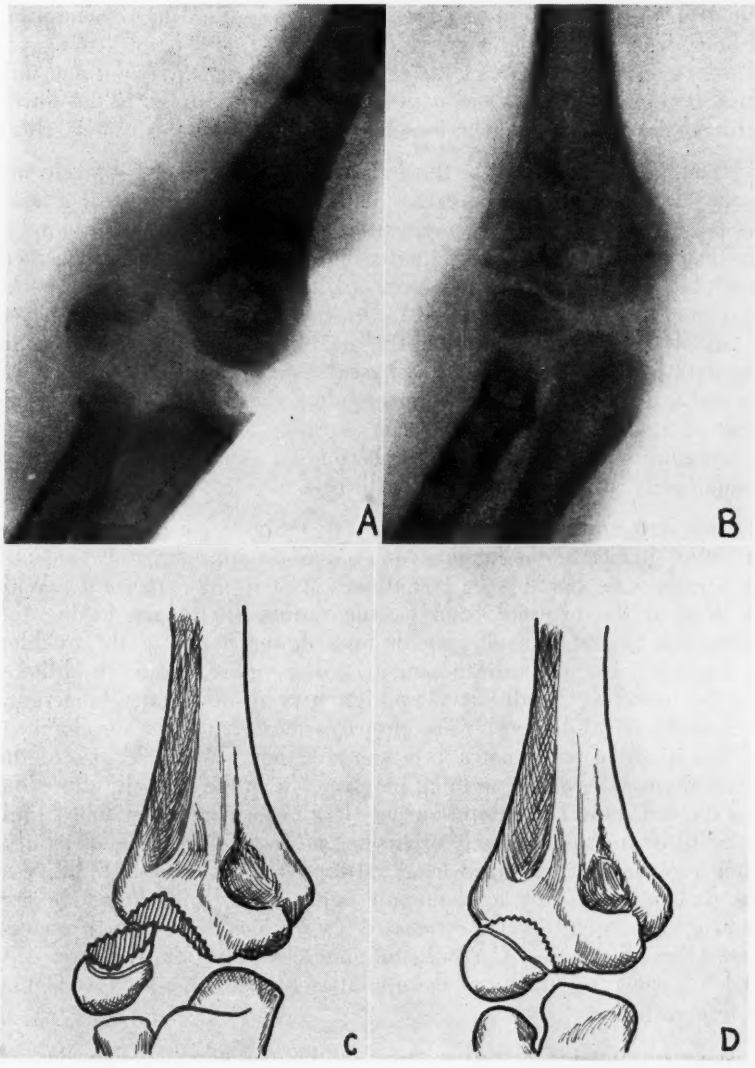

FIGURE 4: A. Fracture of the external condyle in a boy of six. B. Fracture reduced by open method. C. "Three-dimensional" reconstruction from a tracing of the roentgenogram. D. After reduction.

The displaced condyle carries its periosteum with it. This periosteum fills with bone the gap that separates the condyle from the humerus, and as a result the condyle becomes more prominent. This prominence can be felt clinically and is one of the unmistakable signs of a previous

fracture. Another interesting roentgen finding is that no regeneration of bone occurs in the joint where the fracture line separates the capitellum from the trochlea. A little notch develops at this point and this notch becomes larger as the patient grows older. It gives the lower humerus a quasi bifid appearance but does not produce any disability.

When the fracture is of the third class, the very serious displacements occur that jeopardize the integrity of the joint. All periosteal attachments are severed and the fragment is deprived of its blood supply. The exact position varies. Usually the fractured surface is turned around 180 degrees and faces outward, the joint surface looks backward, and the apex points forward. In such a position union can never occur. If allowed to remain, the fragment gradually undergoes certain degenerative changes. The diaphyseal segment atrophies, loses its normal density, and finally disappears altogether. The epiphyseal segment at first expands somewhat, its cartilage is absorbed, it assumes an irregular outline, and eventually becomes a useless and often painful foreign body with or without pseudarthrosis.

More damaging than this is the loss of the growing epiphysis. The articular surface of the humerus is reduced to approximately one-half its former size, but this half continues its normal expansion. With the loss of the external condyle, the radius, no longer having the capitellum to rest against, ascends towards the humerus, the trochlea in a compensatory overdevelopment becomes more and more oblique, and the forearm is gradually forced into a valgus deformity, sometimes as severe as 130 degrees. This prepares the soil for the development of late ulnar neuritis, not a rare complication. With the loss of the internal condyle, the same thing happens but in the opposite direction, and the end result is a cubitus varus. In all cases the elbow shows limitation of motion, particularly extension and in many it becomes painful after vigorous or prolonged use. Always it is an esthetic liability to the patient, frequently an economic one. *It can and should be prevented by suitable early treatment.* Two typical cases are presented here (Figs. 4 and 5). Careful study and consideration of figures 4,A, and 5,A show the futility of manipulation alone. Operative reduction is imperative.

In performing the operation, one should aim at adequate exposure. A longitudinal incision is made directly over the fractured condyle. If this is the internal condyle, the first task is to identify and protect the ulnar nerve which may have been damaged by the original injury. A neurological examination should therefore always be done first. Nerve damage is less apt to occur in fracture of the external condyle. When the fracture line extends quite high on the humeral shaft, however, it is well to isolate the radial nerve before proceeding with the reduction.

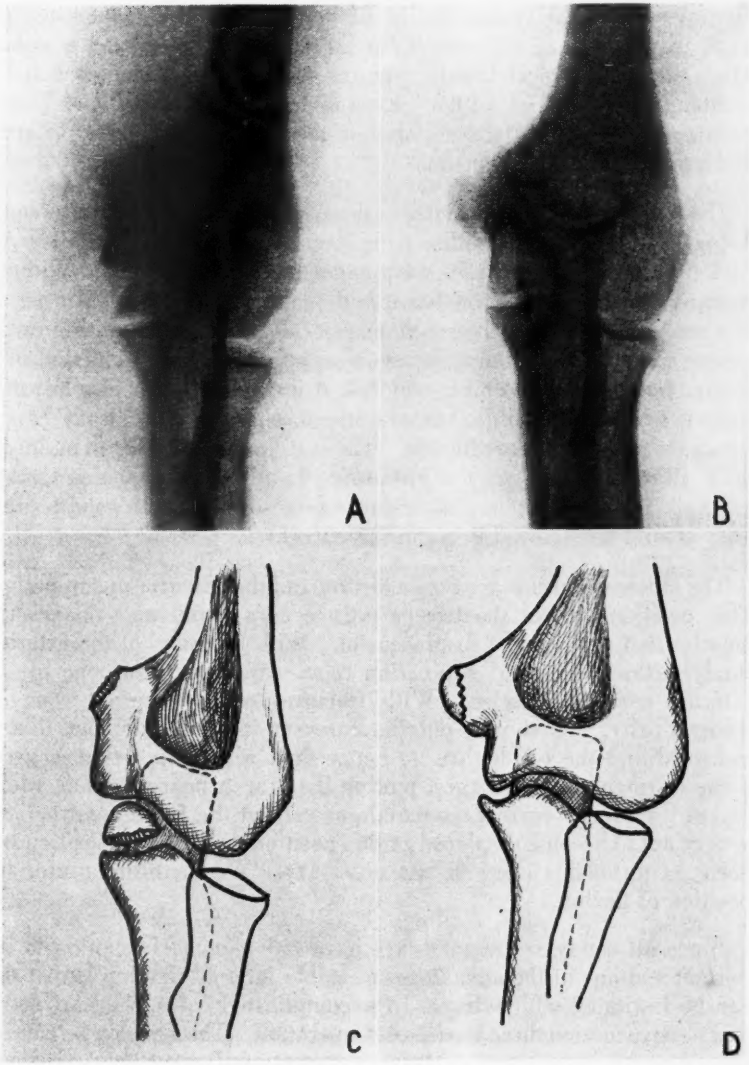

FIGURE 5: A. Fracture of the internal epicondyle in a girl of ten. Note that the epicondylar fragment has been caught in the joint space. There was evidence of slight ulnar palsy which was completely relieved following operation. B. Fracture reduced by open method. C. "Three-dimensional" reconstruction from a tracing of the roentgenogram. D. After reduction.

The fragment is then exposed in front of the joint. It is always larger than the roentgenogram would lead one to believe because it consists for a large part of cartilage. The actual reposition may be a difficult task.

The operative field is necessarily limited and the fragment often so much displaced that replacement is far from easy. Anyone who has struggled with a recalcitrant fragment will realize the utter futility of attempts at closed reduction. Even under direct vision, the obstacles are manifold and the slightest motion of the forearm will cause a change in the position of the fragment.

The type of fixation material will depend on the surgeon's preference. Autogeneous bone pegs, rustless wire, steel bands, and flanged nails have been used, every one with its advantages and disadvantages. Without entering the controversy whether it is the epiphyseal malposition *per se* or a subsequent trophic change that causes the interference with growth, we are emphatic in stating that we are opposed to the introduction of a foreign body across an epiphyseal disk if it can be prevented. For that reason, wherever possible, we now use in children only heavy catgut sutures to maintain our reduction. These are quite sufficient to maintain the position in the majority of instances. In adults the objection to pegs and nails is less strenuous and they may be resorted to with good results. They should be removed in about three weeks.

The elbow is put into moderate flexion and the forearm in supination. This position utilizes the triceps muscle as a splint and relaxes the muscles that produce the displacement. With fractures of the external condyle, the position of supination relaxes the supinator, one of the external condyle muscles. With fractures of the internal condyle, theorectically, one should put the forearm in pronation, but this is awkward and the results are no better than when supination is used. Some German authors suggest putting the arm in near-extension which makes it easier to correct the malalignment but the fractured fragment is very apt to become displaced in this position and if the reposition has been accurate, this check is not necessary. We therefore prefer the position of flexion.

Since all condylar fractures are intra-articular, early motion is important and one of the advantages of stable internal fixation is that this can be instituted with safety. In uncomplicated cases, we start active and passive motion three weeks after operation. The arm can be carried in a sling after this time. Massage is contraindicated because of the great tendency of the bones about the elbow joint to form excessive callus. This complication as well as signs of traumatic neuritis should be carefully watched for. Quite a long time is required before a complete range of motion is restored and this is true even of children in whom joint motion is ordinarily very quick to return. Some limitation of extension is apt to persist for many months, but eventually, with the coöperation of the patient, an excellent result can be obtained.

The problem of what to do with an old condylar fracture that has progressed to nonunion is not an easy one. If the deformity is only mild and joint function fairly adequate though not perfect, it is better not to interfere because delayed reductions do not have the good prognosis of immediate reductions. When the deformity is great, the pain severe, and the motion much limited, a secondary open reduction may be done but the result will be only fair. Sometimes a cuneiform osteotomy of the humerus suffices to improve the appearance. Removal of the loose condyle should be avoided because it leaves the joint more unstable and increases the existing deformity. For this reason, if the removal seems absolutely indicated, it should always be combined with anterior transplantation of the ulnar nerve. Late ulnar neuritis, the result of gradual stretching of the nerve, also calls for anterior transplantation.

Summary

The anatomical and clinical features of fractures of the humeral condyles are briefly discussed. Attention is called to the undesirable sequelae of imperfect reduction. Early recognition and open operative reduction are urged in condylar fractures with significant displacement.

BLOOD PRESSURE CHANGES IN ESSENTIAL HYPERTENSION AFTER EXCISION OF THE CELIAC GANGLION AND DENERVATION OF THE AORTIC PLEXUS

GEORGE CRILE, M. D. AND GEORGE CRILE, JR., M. D.

One of the first operations designed to control elevation of blood pressure in essential hypertension was a unilateral adrenalectomy which was performed by Dr. George Crile in 1915. Since that time, 120 operations designed to control essential hypertension have been performed at the Cleveland Clinic.

A series of eleven unilateral adrenalectomies resulted in only transitory falls of blood pressure levels. Bilateral denervation of the adrenal glands was next attempted, and this procedure resulted in definite symptomatic relief.

In the majority of cases the hypertension was temporarily lessened, and in early cases in young patients lasting relief was obtained. In advanced cases, however, no striking changes in blood pressure were noted. This operation alone is, therefore, not a specific treatment for essential hypertension.

This experience with operations on the adrenal glands led us to abandon the hypothesis that essential hypertension was a disorder resulting from an excessive secretion of adrenalin and forced us to look for other explanations. Working on the hypothesis that the increased peripheral resistance necessary to maintain the hypertension was the result of a spasm of the vascular bed and was mediated by the sympathetic nervous system, Dr. George Crile on May 4, 1934 in addition to the denervation of the adrenal sectioned the left major splanchnic nerve beneath the diaphragm. The operation was performed through a modified kidney incision and was followed by an immediate fall in blood pressure. In the next series of cases the major, minor, and least splanchnic nerves were divided through a subdiaphragmatic approach in fifty-one cases. Greater symptomatic relief followed this procedure.

The blood pressure often showed a dramatic initial fall and in the majority of cases was below the preoperative level when the patient was ready to leave the hospital. The later results were more encouraging than after bilateral denervation alone. These results together with those in the early stages of hypertension and in juvenile cases gave us the impression that we were dealing successfully with the disease and this led us to the study of the comparative anatomy of the adrenal sympathetic complex as a whole. From this study we have come to appreciate the importance of the aortic sympathetic plexus. This plexus was denervated in a series of ten cases, the denervation including

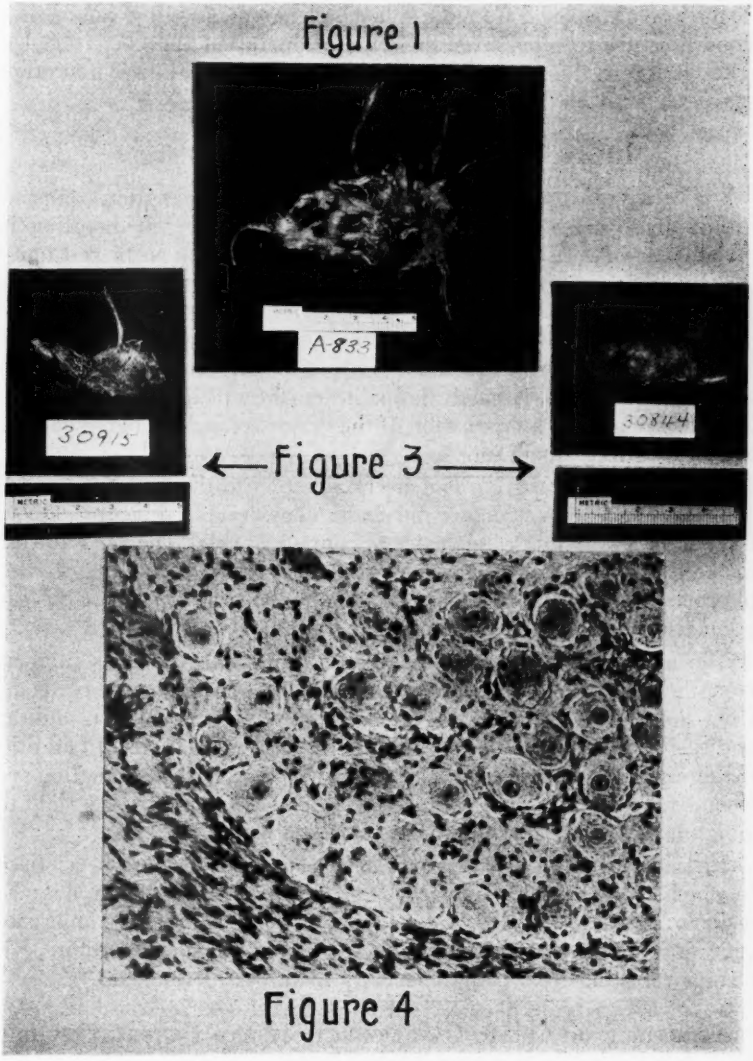

FIGURE 1: Photograph of celiac ganglion and plexus (autopsy specimen).

FIGURE 3: Left and right celiac ganglia removed surgically in cases of essential hypertension.

FIGURE 4: Photomicrograph of celiac ganglion removed from a patient with severe essential hypertension. Note the large ganglion cells interspersed in dense nerve tissue.

section of the branches to this plexus from the ganglionated cords from the adrenal glands and from the splanchnic nerves. A still greater fall in blood pressure resulted from this type of operation and encouraged us to add to it resection of the celiac ganglion. The first of these operations was performed on May 6, 1936.

The Celiac Ganglion and the Aortic Plexus

The celiac plexus is composed of a left and right ganglion connected with a dense maze of nerve fibers. (Fig. 1.) The left ganglion invariably lies directly on the corresponding side of the aorta and into it pass the major and minor splanchnic nerves on that side (Fig. 2). On the right the ganglion lies just to the right of the aorta and into it pass the right major and minor splanchnic nerves. The ganglionic tissue on each side composes a firm mass of about the diameter and thickness of a nickel. This mass is easily palpable on the aortic wall and can be identified definitely by palpation of the major splanchnic nerve entering at its upper outer quadrant.

On the left the ganglion is densely adherent to the aorta and can be mobilized from this structure only with considerable difficulty. On the right it is less closely attached and more movable. The medial sides of the two portions are connected with many tough nerve fibers which intermesh around the celiac artery. On the lateral aspects of the ganglion are numerous branches to the adrenal glands.

The aortic plexus lies below the celiac ganglia, receives branches from the ganglia and branches from the lumbar ganglionated cords and from the least splanchnic nerves. The renal vein which is delicate and easily injured crosses just beneath the celiac ganglion. In addition the suprarenal vein and artery are in close proximity to the ganglion and, when stretched, are easily confused with nerve trunks. On the right the ganglion is in close relation to the vena cava (Fig. 3).

Histologically, the celiac ganglion is composed of dense nerve tissue in which are interspersed numerous large ganglion cells (Fig. 4). Excision of the ganglion removes the ganglion cells and renders impossible regeneration of postganglionic fibers. Theoretically, therefore, any change resulting from ganglionectomy should be permanent.

Technique of Celiac Ganglionectomy and Denervation of the Aortic Plexus

The operation of celiac ganglionectomy is performed in two stages, the left ganglion being removed at the first operation and the right, one week later. The incision starts at the angle formed by the twelfth rib with the sacrospinalis muscle, extends the entire length of the twelfth rib and is curved downward to a point just anterior to the crest of the

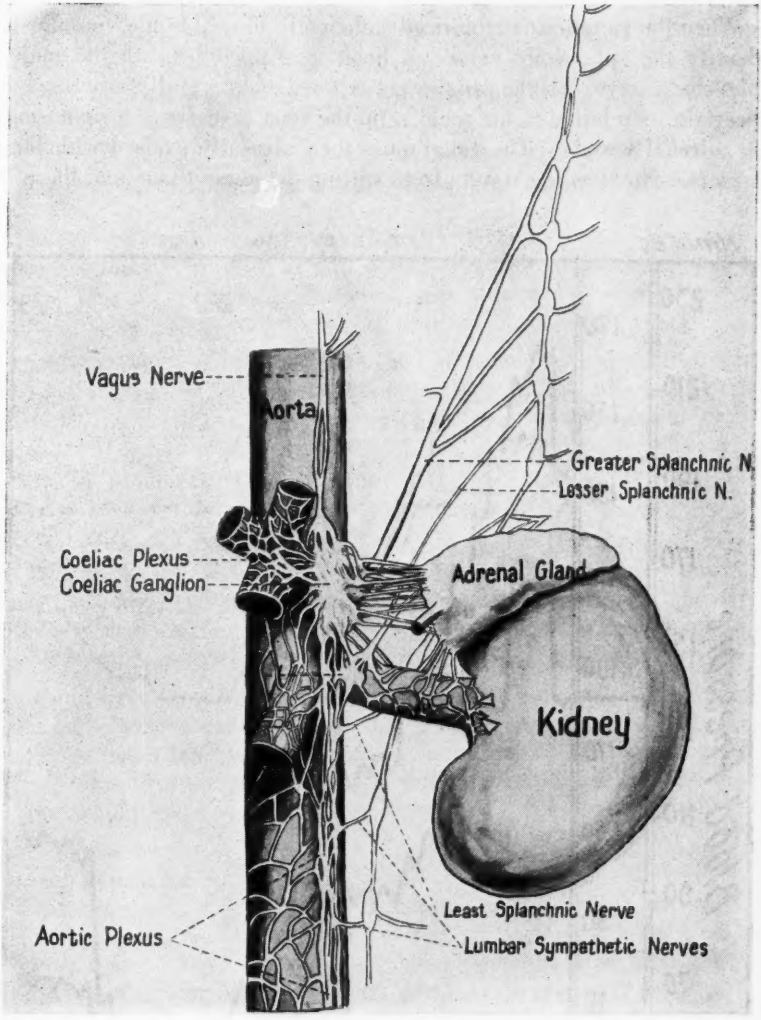

FIGURE 2: Drawing to show relationships of celiac ganglion, splanchnic nerves, and the aortic plexus.

ilium. The quadratus lumborum muscle is divided close to the twelfth rib and the muscles are separated downward to the iliac crest. The lumbodorsal fascia is then incised and the retroperitoneal space widely exposed. The hand is swept along the quadratus lumborum and psoas muscles until the aorta is palpated. The celiac ganglion is easily located by the sense of touch and can be partially mobilized by blunt dissection.

When the ganglion is mobilized sufficiently to enable the operator to identify the splanchnic nerves, a hook is slipped beneath the major splanchnic nerve, and the ganglion is exposed and carefully examined to ascertain its relation to the renal vein, the vena cava (on the right) and the adrenal vessels. The ganglion is then carefully excised with long scissors. No bleeding results from cutting the nerve tissue and there is

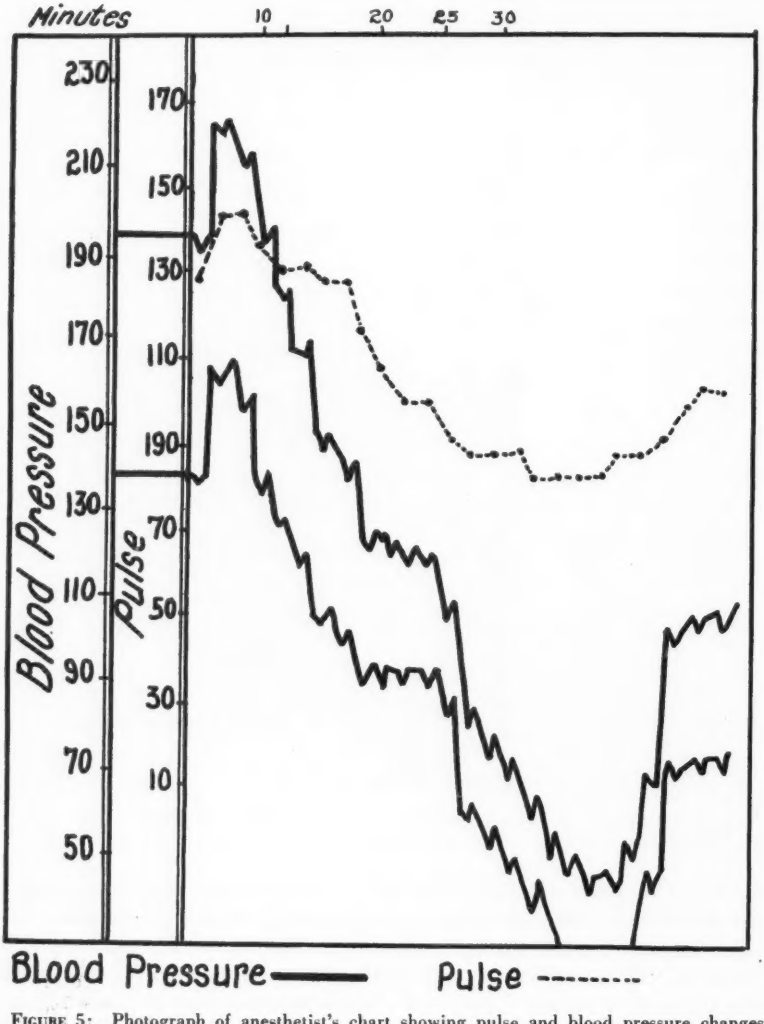

FIGURE 5: Photograph of anesthetist's chart showing pulse and blood pressure changes during operation.

no necessity for cutting the nerve trunks between clamps. The least splanchnic nerve and the branches from the ganglionated chain to the aortic plexus are severed and the component parts of the celiac plexus lying upon the aorta are then divided, thus completing the denervation of the aortic plexus.

Results of Celiac Ganglionectomy

The blood pressure response is usually immediate and dramatic, the pressure falling from 40 to 150 points at the time the ganglion is removed (Fig. 5). The pulse, however, remains slow and of good volume. much like the pulse of a patient under a spinal anesthetic.

The pressure tends to be low for the first six to twenty-four hours, but the systolic pressure never remains below 100 mm. of mercury for more than a few hours. The initial drop is followed by a secondary rise which reaches its peak about the fifth day postoperatively. The pressure then gradually falls and by the tenth day has stabilized itself at a level much lower than the pressure before operation (Fig. 6).

At this time one or both sides of the celiac ganglion have been excised in twenty-seven cases of severe essential hypertension. Three fatalities have occurred, one from hemorrhage from the renal vein, one from bilateral thrombosis of the renal veins, and one from an unexplained hyperthermia, possibly of central nervous system origin.

Aside from the case in which thrombosis of the renal veins resulted in uremia, there have been no instances of serious renal failure. This is a significant observation inasmuch as several of the patients in this group were over sixty years of age, suffered from advanced malignant hypertension, and had poor kidney function.

Although several patients had suffered from anginal attacks or cardiac asthma before the operation and in spite of the fact that severe myocardial damage as indicated by changes in the electrocardiogram was frequently present, we have seen no instance of postoperative cardiac decompensation. The lowering of the blood pressure apparently relieves the myocardium of the excessive burden it is carrying.

Following the operation there is usually a period of from two to six days in which abdominal distress and distention are troublesome complaints. This results from the derangement in the visceral innervation but compensation is soon made and this results in no permanent ill effects.

In half the cases in this group the hypertension had entered the malignant phase as evidenced by the presence of edema of the optic discs. The oldest patient was 62 and the youngest 26, the average age being 43 years.

In eleven cases only the left ganglion was removed, in six cases denervation of the aortic plexus (older type of operation) was done on one side and the celiac ganglion was removed on the other, and in seven cases bilateral excisions of the celiac ganglion and denervation of the aortic plexus were performed.

The average blood pressure level at entry was 223 mm. of mercury systolic, 140 mm. diastolic. The pressure at the end of from one to five days of preoperative bed rest averaged 208 mm. systolic, 130 mm. diastolic. The immediate response of the blood pressure following ganglionectomy was a dramatic fall to an average of 128 mm. systolic, 87 mm. diastolic, this reading representing the blood pressure some hours after the patient's return from the operating room and after recovery from any surgical shock had taken place. The pressure then rose gradually in the next five days to a level nearly as high as that at entry, the average blood pressure at the height of this secondary rise

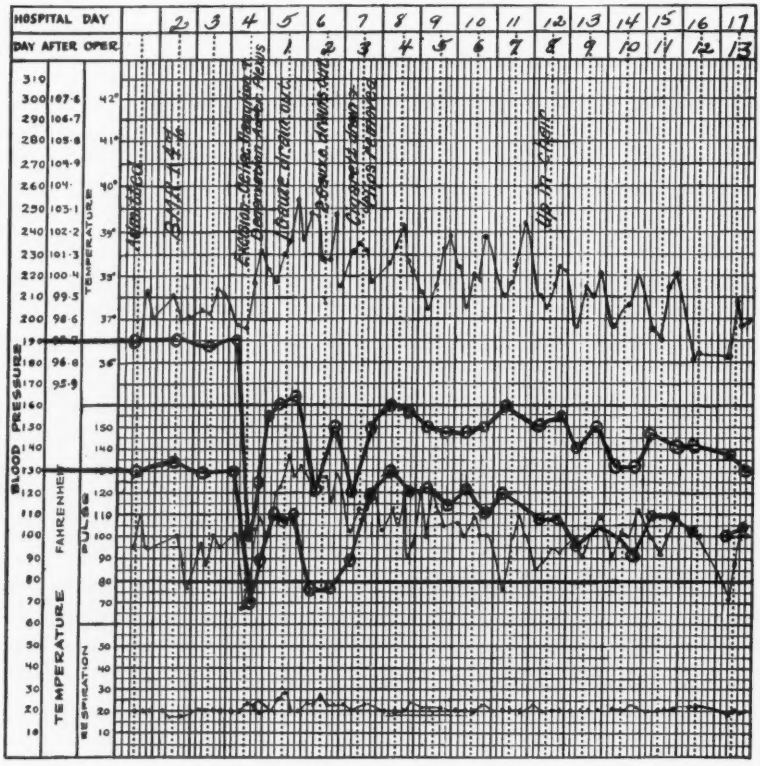

FIGURE 6: Photograph of hospital chart showing typical response of blood pressure to the first stage of the operation.

being 201 mm. systolic, 130 mm. diastolic. Following this rise, the pressures promptly fell again and at discharge on the thirteenth post-operative day the average blood pressure in this group was 166 mm. systolic, 110 mm. diastolic, an average fall of 57 points in the systolic and 30 points in the diastolic pressure.

Eleven patients were followed from two weeks to four months after discharge from the hospital, an average follow-up period of eight weeks. Ten weeks after ganglionectomy and eight weeks after discharge from the hospital, the systolic pressure of this group which averaged 220 mm. at entry was 173 mm. and the diastolic pressure which at entry was 138 mm. averaged 108 mm. (Fig. 7).

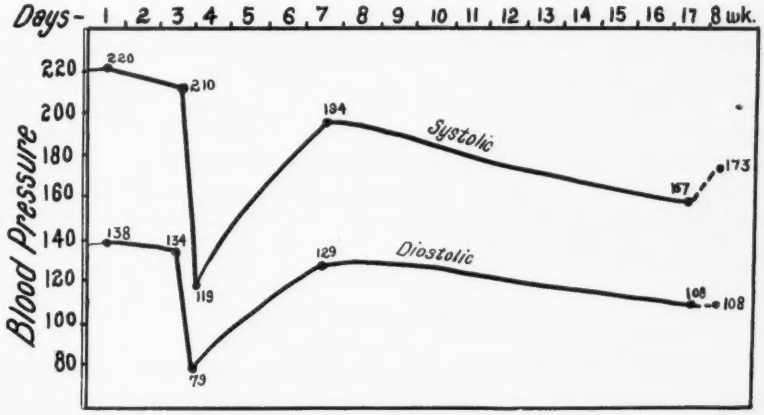

FIGURE 7: Chart of blood pressure changes in 11 cases of celiac ganglionectomy followed for an average of two and one-half months after operation.

The reports on which this follow-up study is based were obtained either from the patient's referring doctor or were taken from the records of subsequent examinations at the Clinic. We have found that the patient's word is not reliable evidence on which to base the follow-up because the doctor will often attempt to encourage the patient by reporting the blood pressure a little lower than it actually is.

In every instance excellent symptomatic relief of headache, dizziness, palpitation, nervousness, etc., was obtained while the patient was in the hospital. In some instances in which only a unilateral operation was performed, a recurrence of symptoms has taken place, and these patients have been advised to have the second operation. Five of the eleven patients who were followed have obtained complete relief from all symptoms referable to their hypertension. Four have obtained partial

relief, and two have not as yet regained enough strength to return to their work and pass judgment on the degree of symptomatic relief obtained.

There are striking variations in the blood pressure response of different individuals to what is, as nearly as we can tell, the same surgical procedure. For example, it happened that two young men, both in their late thirties, entered the hospital at the same time and were in the same room. Both had severe benign essential hypertension with blood pressures averaging 220 mm. systolic, 140 mm. diastolic. In both cases the major portion of the celiac ganglion on the left side was excised and the aortic plexus was denervated, yet in one instance the blood pressure was 80 points lower at discharge than at entry and in the other it was unchanged.

Likewise, to our surprise, we have found that some of our most brilliant results have been secured in older patients with marked arteriosclerosis and vascular disease. We have, therefore, come to believe that the condition of the blood vessels is not a suitable criterion for the selection of cases and that arteriosclerosis, moderate kidney damage, or moderate myocardial damage do not contraindicate operation. In several instances, moreover, we have operated upon patients who have had one or more cerebral accidents, and these patients have responsed no differently than the others.

Indications for Operation

Carefully controlled follow-up studies on many cases of essential hypertension will be required before it can be determined whether or not operations on the sympathetic nervous system will be of prophylactic value against the progress of the disease. We, therefore, cannot as yet recommend a major surgical procedure as a prophylactic measure for patients who are symptom-free or who have early essential hypertension. But when headache, dizziness, palpitation, dyspnea, weakness, and nervousness prevent the patient from carrying out his routine duties, we can assure him that the prospects of obtaining relief of these symptoms by celiac ganglionectomy are excellent. We do not as yet know how long this effect will last, but since the ganglion cells are removed and regeneration of postganglionic fibers hence cannot take place, there is no reason to believe that the benefits may not be lasting. Finally we believe that surgical intervention is most strongly indicated when severe essential hypertension has entered the malignant phase as evidenced by edema of the optic discs. As a rule such patients are not only incapacitated for useful work but are doomed as unequivocally as if they suffered from an inoperable malignancy. Fortunately, the initial results in this group have been as satisfactory as those in the less advanced cases.

Summary

1. The results of 120 operations on the sympathetic adrenal system for the control of essential hypertension are discussed.

2. Operations on the adrenal gland and splanchnic nerves have given relief from the symptoms of hypertension but have not resulted in striking alterations of blood pressure.

3. The celiac ganglia and aortic plexus receive the major, minor, and least splanchnic nerves and send fibers to the adrenals and to the splanchnic vessels. Excision of the ganglia and denervation of the aortic plexus removes the ganglion cells and insures against the regeneration of postganglionic fibers.

4. The initial fall of blood pressure and symptomatic relief following excision of the celiac ganglion have been more promising than in any other procedure that we have hitherto attempted.

5. Moderate degrees of arteriosclerosis, myocardial damage, or kidney damage do not contraindicate operative intervention in essential hypertension.

6. The average blood pressure level of eleven patients with severe essential hypertension at the time of entry to the hospital was 220 mm. systolic and 138 mm. diastolic. Ten weeks after excision of the celiac ganglion the average blood pressure level of this group was 173 mm. systolic and 108 mm. diastolic.

ENDOSCOPY AS AN AID IN DIAGNOSIS AND TREATMENT

PAUL M. MOORE, M. D.

Although endoscopy has been developed comparatively recently, it has firmly established itself as an almost indispensable method in the diagnosis and treatment of many hitherto inaccessible conditions. It has made great strides since its advent some thirty-five years ago.

The most spectacular use of the endoscope, especially in the eyes of the laity, has been in the removal of foreign bodies from the food and air passages. Before its conception, these patients either had to dislodge the foreign bodies themselves or submit to daring and dangerous surgery, or the condition was regarded as hopeless. Yet even today when it is generally known that bronchoscopy and esophagoscopy are the surest means of removing such foreign bodies, many cases are not diagnosed soon enough and some patients are treated too long by the watchful waiting method. It is often true that when a small piece of bone is swallowed, the mucosa is scratched in passing. This leaves the patient with the sensation of some obstruction, and the act of swallowing produces pain at the site of the scratch. Such patients should soon become asymptomatic. The safest procedure in such instances is to immediately make a roentgen examination of the esophagus both with and without barium. If the symptoms persist for more than 48 hours, the patient should be examined with the esophagoscope. Within the past year a young girl came into one of the State University Hospitals complaining of severe hemorrhage from the mouth and tarry stools. She said a chicken bone had become lodged in the esophagus some six weeks previously. The discomfort had persisted but had grown less from day to day, so nothing had been done about it. Because of her condition, the esophagoscope was not used. She was given transfusions but failed to rally. At autopsy a chicken bone was found lying crosswise in the esophagus; it had eroded into the descending aorta producing the fatal hemorrhage. Had esophagoscopy been instituted immediately after the foreign body had become lodged, undoubtedly this patient would still be living today. A number of similar cases are recorded in the literature.

Mediastinitis is another dreaded complication. It cannot always be prevented, for some foreign bodies are very sharp and pierce the thin walls of the esophagus rather rapidly. However, the prompt removal of the foreign body will materially decrease the danger.

In the case of foreign bodies in the bronchi it is often very difficult to make the diagnosis without bronchoscopy. If the patient is seen by a member of the family at the time of aspiration, the story is quite typical. There is a sudden attack of coughing, usually accompanied by cyanosis. This generally quiets down after a bit and the child seems fairly well

except that there are recurring attacks of coughing, and he becomes somewhat listless and loses his interest in his play. If he is not seen during the initial attack, the picture can readily be confused with croup or bronchitis.

If the foreign body is metallic, it will easily be distinguished on the x-ray film. If it is of vegetable origin, such as a peanut or a bean, the roentgenogram will not show the object itself but the results of its presence are usually evident, especially if it is causing obstruction of one of the main bronchi. There will be a difference in the density of the two sides of the chest with a shifting of the mediastinal contents. If the obstruction is partial, allowing some passage of air on inspiration and expiration, little or no difference between the two sides may be seen. On examination of the chest some signs are almost always found. There is limitation of movement and diminished or absent breath sounds on the affected side no matter what type of obstruction is present. With partial obstruction, there is dullness on the affected side and râles are present. When obstruction is complete, atelectasis of the affected side develops and there is marked dullness and a shifting of the mediastinal contents to that side. If the obstruction is of the ball-valve type, allowing air to pass on inspiration but none on expiration, the lung on the affected side is gradually inflated until the picture of pneumothorax is simulated. A tympanitic note is obtained on percussion and the mediastinum is shifted toward the opposite or unaffected side. In this type of obstruction vocal resonance and fremitus are little affected, while in the other type they are both decreased on the side of the obstruction.

The vegetable foreign body, especially the peanut, frequently produces pneumonia rather soon, so one has the picture of actual chest infection to cloud the issue. In all cases where there are reasons to suspect the presence of a foreign body, a careful study and bronchoscopy should be done. This may save many lives and prevent some lung abscesses.

When lung abscesses have developed from any cause, the diagnosis can be confirmed by bronchoscopy and lung mapping. If the lung abscess drains readily into the bronchi, repeated aspirations at weekly intervals will materially aid recovery. If the abscess is not of long standing so that it is not surrounded by scar tissue which prevents its collapse, the aspirations may be all that are required to effect a cure. If they do not accomplish this, they will improve the patient's general condition so that he is better able to stand surgical drainage.

In bronchiectasis the outlook is not as bright, unless the patient is treated very early. If he is a child and the disease is not too well established, bronchoscopic aspirations at weekly or two weekly intervals may effect a symptomatic cure. These must always be assisted by daily

postural drainage and all active infection in the nose, throat, and sinuses must be removed.

For those patients who have had bronchiectasis over a long period of time, the aspiration treatment offers symptomatic improvement and better general health. If the bronchiectasis is limited to one lobe or one side, the treatment can be used to prepare the patient for surgical removal of the affected tissue. One patient, whose pathology was too extensive for surgery, has been under treatment for six or seven years. When first seen she was a scrawny child, just skin and bones. The right side of the chest was almost opaque to the x-ray and she was raising large quantities of pus. Today she is a buxom young woman. The right lung is clear to x-ray but an extensive bronchiectasis remains. Fairly large quantities of pus are still aspirated at treatment but she feels well, is active, and considers the treatments well worth her while.

There is one type of acute infection where the bronchoscope is of great value. This is when a so-called mucous plug develops in one of the bronchi. It is a collection of mucopus which is too thick for the patient to raise and, as a result, the bronchus is completely occluded and the lung on that side collapses. The patient presents the picture of atelectasis on one side, high fever, and prostration. The mucous plug can be removed by bronchoscopy and aspiration. The lung immediately fills with air and the patient begins to improve. The procedure may have to be repeated if the plug forms again but rarely more than two treatments are required.

The diagnosis of malignant growths of the lung and esophagus has been materially helped by endoscopy. The growth can frequently be visualized and a biopsy taken which establishes the diagnosis. In patients who are unable to swallow because of stricture of the esophagus or cardiospasm, the nature of the obstruction can be seen through the esophagoscope and the degree of the obstruction determined with soft nose dilators. If it is a cardiospasm, repeated dilations will give relief. If the stricture is due to some chemical cautery such as lye, a gastrostomy followed by retrograde dilations is indicated.

EXOPHTHALMOS*

A. D. Ruedemann, M. D.

BILATERAL EXOPHTHALMOS IN ADULTS

Bilateral exophthalmos occurs more commonly in adults than in children, offers more difficulty in diagnosis, and, as a rule, is not as easy to treat. Blood disturbances such as spontaneous leukemic and traumatic hemorrhages cause some cases, and a rare type of glandular and blood disease known as Mikulicz's disease, as well as other types of leukemia, may be responsible for other cases. The exophthalmos associated with trichinosis, allergy, and serous tenonitis is mainly due to edema while in hyperthyroidism, malignant exophthalmos, hypothyroidism, and hypertension the proptosis is caused by edema, but the tissue finally becomes fibrotic and solid. Cerebral aneurysms may produce bilateral exophthalmos, as may cavernous sinus thrombosis or lateral sinus thrombosis. Paget's disease and acromegaly cause deformities in the skull which produce exophthalmos analogous to that seen in tower skull and hydrocephalus in children. However, in neither of these diseases is exophthalmos a prominent or important sign. Exophthalmos may result from muscular relaxation due to external ophthalmoplegia, but this is rare.

The most common cause of bilateral exophthalmos in adults, as well as in children, is disease of the thyroid gland. Hyperthyroidism or toxic goiter is a common, devastating, general disease which seriously affects the eyes and is often injudiciously treated by surgeons and oculists alike.

Hemorrhage

The conditions that cause hemorrhage producing exophthalmos in children will do the same in adults, and in the latter, arteriosclerosis is responsible for an occasional case of this type. The incidence of exophthalmos from hemorrhage is greater in adults than in children, where in cases of scurvy, hemorrhage may occur.

Spontaneous hemorrhage: Spontaneous hemorrhage in an adult does occur, although it is extremely rare. It usually produces a unilateral exophthalmos, but cases have been reported in which it was bilateral. I have seen one patient who had orbital hemorrhages which produced unequal exophthalmos due to severe and fatal myelogenous leukemia.

Hemorrhage from trauma: Bilateral hemorrhages due to trauma are more commonly due to automobile accidents. However, in several patients who had been "slugged" by hold-up men, there was mild

*This is the second of four papers on exophthalmos and protrusion of the eyeball. The remaining papers will appear in subsequent issues of the Quarterly.

exophthalmos from orbital hemorrhages. These patients may also have bleeding from the nose and ears.

Hemorrhage due to asphyxia: Asphyxia produces hemorrhages in the orbit due to compression of the chest; retinal hemorrhages may also be present. In patients with asphyxia following the Cleveland Clinic disaster, the lids had an edematous, boggy appearance, and exophthalmos, evidently secondary to the venous stasis and tissue edema, was present in many instances.

Scurvy: Scurvy may produce orbital hemorrhage with exophthalmos in adults, although in all the literature only one reference is made to this and then only one eye was affected.

Increase in Orbital Tissue

Leukemia, Mikulicz's disease, lymphoma, lymphoblastoma: A syndrome including enlargement of the lachrymal, salivary, and buccal glands was first described by Mikulicz in 1892. Many reports of the condition have appeared in the literature since that time, and individual instances of the disease present wide variations.

Howard suggests the following classification of the disease: (1) the syndrome as described by Mikulicz, accompanied by no alteration in blood or enlargement of lymphatic glands; (2) Mikulicz's disease, plus enlargement of the lymphatic glands, but with no increase in the number of leukocytes; and (3) the same clinical picture due to leukemia *per se*.

Owen and Hennessey reported a case in which there was tremendous enlargement of the lachrymal glands. Removal of some of the tissue revealed a dense mass of lymphoid cells embedded in a fine stroma; no eosinophils or giant cells were present.

Exophthalmos is one of the signs of this disease, being due to invasion of the lachrymal tissue by the lymphomatous mass. The protrusion is down and in and is not great, whereas the lid involvement may be of extreme degree, and the patient may have difficulty in opening the lids. Removal of some of the tumor mass may be advisable, but roentgenotherapy has been so beneficial in two patients I have seen recently that I feel this treatment deserves a trial before operation is undertaken.

The first patient, an elderly woman, had enlargement of one lachrymal gland with little exophthalmos, but considerable diplopia. The parotid and salivary glands were also enlarged. The other patient, a man, had swelling of both lachrymal glands, both parotid glands, and both salivary glands. In this instance, too, the exophthalmos was not great, only 3 to 4 mm. The blood picture revealed an increase in the lymphocytes. Following the roentgenotherapy, the exophthalmos decreased in both patients.

In the other forms of leukemia, the solution of the problem often

depends upon the type of cell involved in the process. My personal experience has been with two cases in which the clinical diagnosis was chronic lymphoma involving the orbits, usually the anterior portion, and producing more lateral displacement than exophthalmos. One patient died with a large tumorous mass of the brain and the other from a growth which eventually was diagnosed as lymphosarcoma or questionable hypernephroma.

Martin Cohen reports a case of lymphoma and Algernon Reese a case of leukemia in which exophthalmos was the primary sign of the disease, and the blood findings and biopsy substantiated the diagnosis.

The blood picture need not be positive for a diagnosis of leukemia to be made because the tissue is all that is necessary to classify the growth as of leukemic origin. However, from my own experience and a careful review of the literature on the points of differentiation in this disease, it is my opinion that the condition should be diagnosed as to gross type and that general treatment with roentgen irradiation should be attempted in an effort to reduce the size of the masses. It usually is possible to find some lymph glands, either in the groin or axilla, that are invaded, and the questionable blood findings do not alter the indications for irradiation or even the prognosis in most instances.

The protrusion of the eyes is not great and usually is not straight forward. No diagnostic value can be attached to this, however, as each patient presents an individual problem.

Bilateral tumor masses: Bilateral tumors are extremely rare and usually are of unequal size. One patient, whose course was rapidly fatal, had a chondrosarcoma of the sphenoidal sinuses; this rapidly invaded both orbits from the apex. Roentgen examination revealed the destruction of the bone and examination of the nasopharynx showed invasion of the posterior nasal fossa.

Malignant neoplasms may invade the orbit at the apex, posteriorly or mesially, or from below. Our experience has been that most invading growths from the antrum are carcinomas, whereas sarcomas may extend from the sphenoidal, ethmoidal, or frontal areas.

A diagnosis of exophthalmos due to growths of this type is not easy to establish, although by exclusion and careful examination of the nose and throat, one usually can find a clue in the sinus area somewhere.

Exophthalmos Due to Edema, Venous Stasis, etc.

In this group of conditions, the exophthalmos is brought about by edema of the tissue due to venous stasis or other local conditions.

Trichinosis: Exophthalmos due to trichinosis is infrequently reported and quite commonly overlooked in making a diagnosis. I have seen two patients with trichinosis in whom the local picture was a fluid

edema with mild exophthalmos and much edema of the lid, and I missed the diagnosis in both instances.

The eye signs precede the general symptoms but do not last so long, whereas the systemic signs are slow in onset and may persist an exceedingly long time. In addition to edema of the lids, there may be some pain in the orbit and slight immobility. Otherwise, the examination of the eyes reveals nothing abnormal. However, the blood picture with the very high eosinophil count, sometimes as high as 65 per cent, with gradual recession and the muscular pain are typical of the disease.

The larval invasion, at the end of three or four days, produces generalized muscular pain, soreness, fever, headache, and orbital edema. The disease can be confused with sinus disease, typhoid fever, influenza, and some other general systemic diseases.

The history may give valuable information as to the time of ingestion of the pork. Equally important, however, is the type of pork eaten as well as the place of purchase. Pork sausage (bologna type) and barbecued pork, and the pork used in chop suey houses are the chief offenders. At present, pork is inspected externally only and no microscopic study is made. Trichinosis is widespread in the pig, and man, as a secondary host, is more commonly infested than would be expected from the number of cases reported in the literature.

In early exophthalmos when edema of the lids, malaise, and leukocytosis, especially with a marked increase in eosinophils are present, the diagnosis of trichinosis should be suspected. A microscopic section which reveals the parasites establishes the diagnosis. These worms become encysted and live for a considerable period of time, and the host may be aware of their presence only because of excessive fatigue.

Treatment of this disease is unsatisfactory from a medical point of view. No known treatment has proved consistently efficacious.

Tenonitis: Tenonitis, either serous or purulent, produces exophthalmos in adults similar to that described under the same heading in children.

Serous tenonitis is fairly unusual; however, its occurrence is sufficiently frequent to warrant attention. Slight exophthalmos, which is usually unilateral, associated with a straw-colored edema of the conjunctiva and pain on movement of the eyes, and severe headaches are the common signs. Increase in the number of white blood cells and moderate increase in temperature are additional findings of significance. The second eye is affected usually within three or four days after the symptoms appear in the first.

The use of diathermy, hot packs, and salicylates are efficacious in treatment. The patients recover fairly rapidly but remissions are not unusual.

Exophthalmos due to purulent tenonitis usually is unilateral and is characterized by severe pain, inflammation, and leukocytosis, which may be followed by protrusion of the globe, loss of the sight or loss of the eye, and eventually, meningitis and death. This is a serious condition and warrants immediate care and constant observation.

Cavernous sinus thrombosis and stasis: Cavernous sinus thrombosis is usually a fatal disease which should not be confused with other conditions around the eyes. In spite of its severity and relative frequency, a diagnosis is not made in many cases almost to the time of the patient's death.

Severe fever and cerebral symptoms, varying from delirium to dementia, are common signs. Venous engorgement, conjunctival edema, heavy lids, proptosis, and intra-ocular lesions are all present in a well advanced case. The history is important, and a boil on the nose, a sty, or a minute skin infection may precede the later complications. Although generally unilateral, it is not unusual for the disease to involve the sinus and orbit on the opposite side shortly before the patient's death.

An excellent book by Turner and Reynolds covers the subject fully and points out the venous channels which the infection follows. There are no criteria for predicting which patient with a minor infection may be afflicted with this complication, and our present knowledge is not sufficient to prognosticate the course of the infection. The advice is needless that all infections of the face which involve the upper lip, nose, and eyes should be carefully watched and treated to prevent extension of the inflammation. The patient should be at complete rest, and general measures in addition to magnesium sulphate dressings should be instituted early.

A number of cases of so-called cavernous sinus stasis have been reported in the literature and I have observed one personally. Transitory edema of the orbit with irregular exophthalmos was present for which no cause could be found. Dr. John Phillips, after numerous observations, concluded that some obstruction of the cavernous sinuses was present. The edema of the disc was severe, as was the vascular stasis. The patient was followed for several years, but eventually could not be traced.

Unilateral exophthalmos has been noted when brain tumors had compressed the sinuses. A severe progressive disease of the orbits associated with fever, headache, pain, and transitory delirium should arouse suspicion of some complications in the cavernous sinus.

Hyperthyroidism: Toxic goiter was first described by Parry in 1825, and later by Graves who listed three cardinal signs—tremor, tachycardia, and exophthalmos. Since that time, other symptoms and

signs have been added such as the increased basal metabolic rate, loss of weight, excessive flushing of the skin, irritability, perspiration of the hands and feet, and nervousness which progresses at times to psychosis and dementia. This is a serious disease and exophthalmos is one of the serious and difficult problems it presents.

Widening of the palpebral fissures is observed more frequently than exophthalmos and usually precedes the latter by at least a month. Widening of the fissures is not a constant accompaniment of exophthalmos, but, when present, may be unequal and unilateral. It is caused by a spasm of the levator palpebrae. A spasm of the orbicularis oculi sometimes offsets to a slight extent the palpebral widening, but this occurs only rarely.

The orbital fissure is usually 9 mm. wide, but measurements as high as 22 mm. have been recorded without proptosis of the eye, and greater widening has been observed in conjunction with exophthalmos. Widening of the fissures is the disorder of the eye most commonly seen in photographs of patients with thyroid disease. In this type of case, brilliant surgical results are achieved and the condition is most distressing if not relieved by operation, since it persists to haunt the patient cosmetically by virtue of his friends' lamentations and his own persistent lachrymation.

A unilateral retraction frequently is responsible for the mistaken diagnosis of unilateral exophthalmos, as well as that of unilateral ptosis, whereas the actual picture is usually a normal anterioposterior position with retraction of the lid on one side and with a partially successful attempt of the orbicularis to overcome the levator spasm on the other side.

The widening of the fissures bears no relationship to the severity of the hyperthyroidism and is a common finding in neurocirculatory asthenia and in cases of paralysis of the superior rectus muscle in which the levator attempts to compensate. When the widening is extreme, the eyeball must be protected, as the cornea dries at night. Lid sutures usually are unsuccessful, especially in conjunction with exophthalmos, although it is sometimes possible to bring the lower lid up (Frost's method), using a collodium skin dressing to help support the skin of the face.

Widening of the fissures is not present in all cases of hyperthyroidism, but it is a frequent and early sign and probably accounts for the following accompanying ocular signs and symptoms.

a. Lid lag which is due to poor coördination between the levator and other muscles of the eye, especially the inferior rectus. A persistent, wide fissure may require operation on the lids, and, of the three procedures advised, tarsorrhaphy is preferable. This yields satisfactory

results, is not difficult to perform, and does not require hospitalization or closing of the eyes.

b. Photophobia is a secondary feature due to exposure keratitis and total exposure of the entire cornea and pupil to light. The levator spasm does not allow the lids to relax, even in the brightest light. Patients so afflicted should wear tinted lenses when they are in the sunlight.

Exophthalmos, originally listed as one of the triate of symptoms in Graves' disease, is not present in every case of toxic goiter, but is observed in the majority of cases. It is not present in cases of large colloid goiter unless some toxicity is present, nor can it be found in patients with thyroiditis, simple adenoma, or carcinoma. When it is present in these types of thyroid disease, there is always evidence of hyperthyroidism. The size of the gland is not indicative of its toxicity, nor is the exophthalmos a sign of the severity of the disease.

Every instance of exophthalmos in hyperthyroidism in my series of over 5,000 cases was bilateral. Using 20 mm. as a high normal value, unilateral proptosis was not evident in a single case. The protrusion may be unequal, but in only a few instances was there more than 3 mm. difference, and in only two cases did the difference in measurements amount to more than 5 mm. The degree of protrusion varies tremendously and may result in anterior luxation of the globe with blindness and, frequently, death. However, extensive protrusion is not always the cause of anterior luxation. There is a decided tendency of some eyes to luxate early, and it must be attributed to a weak anterior fascia and a marked spasm of the levator palpebrae plus the rapid development of edema. These patients, in whom the condition progresses rapidly to luxation, are usually of advanced age—almost always more than fifty years of age. Frequently there is an associated severe cardiac condition (myocardial degeneration) or dementia, or both. Luxation as a rule is followed by death.

The duration of the exophthalmos before operation prognosticates the amount of recession to be expected after removal of the thyroid gland. Definite promises should not be made, however, for in my series, the average recession after operation was only 2 mm. In early cases, the recession is more marked, but in advanced cases there is little if any return toward normal.

In every case of exophthalmos due to thyroid disease, careful measurements should be recorded and, if the condition is progressive, the patient should be subjected to thyroidectomy. Of the three types of treatment, medical, surgical, and irradiation, operation performed early in the course of the disease offers the best results so far as the exophthalmos is concerned.

Exophthalmos which makes its initial appearance following operations on the thyroid gland and exophthalmos which progresses after operation are extremely distressing complications and are caused by several factors. In the first place, the so-called recurring hyperthyroidism may be due to retention of too much glandular tissue and this requires further removal. However, the eyes should be observed carefully, for the condition may be the result of acute hypometabolism with rapid edema simulating the exophthalmos of hyperthyroidism, and, in this event, removal of additional thyroid tissue may be fatal to the patient or at least may cause serious damage to the eyes.

Secondly, exophthalmos coming on postoperatively presents unquestionably the most devastatingly severe type of protrusion to be found in conjunction with thyroid disease. In the first place, it simulates severe myxedema of the orbit rather than edema due to hyperthyroidism, and hence really represents a different process which will be discussed under the heading of malignant exophthalmos. In my opinion, this type is evidence of a true polyglandular disease.

Thirdly, there is a group of patients with truly recurrent hyperthyroidism, in whom the exophthalmos halts for a period, recurs, and becomes increasingly, though slightly, worse after each attack. In my experience, operation offers these patients more than any other treatment although, in some instances, several operations may be required.

A corneal dystrophy occurs in association with the exophthalmos of hyperthyroidism that is not found in retraction of the lids in any other cases of exophthalmos; it simulates that associated with the postsurgical dystrophy of tic doloureaux. The areas are rarely infected and the degeneration of the globe is not due to a primary infection. A low-grade iritis has also been noted in several cases. Evidence in some instances points to a vascular embarrassment, whereas in others, the process seems to be of a neuroparalytic type. These patients with corneal involvement respond immediately to removal of the thyroid gland and it is our practice to operate earlier under these circumstances in order to relieve the condition in the cornea. Since instituting this procedure, no eyes have been lost, and the ulcers have responded with no additional treatment.

Keratitis lag ophthalmitis occurs only in certain individual cases, and many patients with wide protrusion suffer no corneal disturbances.

Lachrymation is a common disturbance in exophthalmos and is due to exposure and stimulation of the lachrymal glands. An irritative type of conjunctivitis also is frequently present and this is relieved by general treatment and relaxation of the lids following operation.

To correct the failure of the lids to close at night, there is nothing so satisfactory as a well-fitted Buller or cellophan shield. Suturing of

the lids and similar procedures are treacherous and illogical because the edema can not be pressed out and the posterior pressure is then magnified against the cornea or the sutures. A more rational procedure is to apply vaselined gauze (super-saturated) over the eyes at night, and most efficacious of all is early operation on the thyroid gland.

In conjunction with these cases of exophthalmos, there have been ten instances of transitory glaucoma and one in which the glaucoma persisted. The tension reading recorded 90 mm. (Schiötz) in one case and all the readings were fairly high. All except one of these patients were relieved by thyroidectomy and that one had myopia with glaucoma, exophthalmos, and postoperative hypometabolism. This patient required eserine over a period of ten years. Changes in the visual fields were not present in these patients, with the exception of the last. I believe that increase in intra-ocular pressure accounted for the severe headaches of which these patients complained. In all these instances, the disturbance was bilateral, all patients were adults, and intra-ocular surgery was not necessary in any case.

No visual field changes of diagnostic importance occur in toxic hyperthyroidism. In all our cases, the fields were normal or the changes observed were merely coincidental. The results of studies of the fields in this group are almost identical with those in a group of normal patients.

Another associated sign of exophthalmos in hyperthyroidism is edema of the lid, usually of the upper lid. The lower lid is rarely affected except in cases of long standing, and, if present, it is a good indication that the exophthalmos has been present for considerable time. In patients with edema of the lower lid, there is very little recession of the eyes after operation. The edema of the lid, however, is exactly the same as the orbital edema—fluid in the early stages, which is followed by lymphocytic infiltration (mild in some cases) and later, by fibrosis not unlike myxedema.

Many of the other ocular signs of thyroid disease are merely secondary and are infrequently observed. However, a disturbance of muscular function occurs quite frequently. The weakness of accommodation convergence (Möbius' sign) is common in exophthalmic goiter, persists long after operation or medical treatment, and may require special muscle exercises or prisms before the patient is able to work and become rehabilitated economically. Of all the eye signs, this one is the most persistent, and years after the patient is "cured" of the disease, the muscle error may lead him a disagreeable chase from oculist to surgeon to oculist.

Other muscles are similarly involved and isolated muscle paralysis is common. The two muscles most frequently involved are the right

superior rectus and the right external rectus. Much of the dysfunction corrects itself in time and from six months to a year should elapse before any operation is undertaken on the ocular muscles. Recovery from thyroid disease is very slow because the disease affects the entire system, and naturally the rebound is not rapid.

Bilateral involvement of the muscles is more than coincidental. At least six cases of bilateral paralysis of the superior rectus muscles have been seen and in these instances, as one would expect, the fissures are exceedingly wide. The patients of necessity carry their heads well back and the muscles of the neck suffer spasm and cause pain.

The internal recti may be weakened but are rarely paralyzed. The oblique muscles are frequently involved. However, cases are on record of involvement of the oblique muscles and of the inferior recti. The head tilts in these instances are similar to those noted in the presence of hyperphoria.

One patient has presented an interesting story. Following operation, he suffered from hypometabolism and is now going through a second remission of myasthenia gravis. Treatment to date has carried him along and his basal metabolic rate has ranged from plus 54 to minus 36 per cent. The myasthenia was discovered when the metabolic rate was low.

Complete external ophthalmoplegia was noted in two patients with exophthalmos, one in whom it was severe, and the other with slight proptosis. Both these patients succumbed before treatment could be instituted. One had definite symptoms and signs of cerebral involvement, and the other was mentally normal the afternoon when his death occurred due to cardiac failure.

Changes in the pupil, iris, retina, and nerve head are diagnostically of no value in hyperthyroidism, because they are rarely involved in true toxic goiter. No significant diagnostic sign can be attached to any changes in these parts.

A study of the capillaries in a number of patients with exophthalmos reveals a definite venous stasis and subconjunctival edema. Another interesting finding is a collection of what appear to be oil droplets along the deeper and larger vessels. In some instances, these are so extensive as to completely surround the vessels although I have been unable to determine what their significance may be. Their presence is constant enough to make one feel that some faulty exchange of tissue lipids may play a part in the production of orbital edema. These oil droplets are especially numerous in cases of malignant exophthalmos.

The description by Moore of the orbital contents is typical for our findings in all cases of exophthalmos of short duration. "I therefore made an incision the entire length of the inferior conjunctival fornix,

exposed the contents of the orbit, and with forceps picked away piecemeal as much oribital fat as possible. I estimate that a heaped up teaspoonful was thus removed . . . In addition, however, the fat seemed edematous, and in particular the inferior, internal and external recti muscles, which were exposed for a considerable distance, and these, instead of being the flat, rubber-like muscles, such as we become familiar with in squint operation, were greatly swollen, fusiform bellies, apparently from edematous infiltration, not quite so stout as the last joint over the little finger."

The importance of establishing a diagnosis of exophthalmos is emphasized in cases of neurocirculatory asthenia. Because the general symptomatology similates that of thyroid disease so closely, the eyes are an important aid in the differential diagnosis. The patients show moderately high basal metabolic rates, rapid pulse, tremor, and loss of weight; they also are extremely apprehensive. Examination of the eyes reveals a retraction of the lids due to levator stimulation and not to true spasm, some lid lag but no exophthalmos, never any muscle palsies and usually dilated pupils which are absent in true thyroid disease. Furthermore, if these patients are placed in bed at complete rest, the basal metabolic rate decreases 20 to 30 points and the heart rate becomes slower. In this group of patients, an erroneous diagnosis of hyperthyroidism is often made and poor results follow operation on the thyroid gland while some of the most brilliant results are secured following treatment of "exophthalmos." These are the patients who, in my opinion, are afflicted with the most severe type of proptosis with which we have to deal, namely, "malignant exophthalmos" which develops following thyroidectomy.

PRESENT CONCEPTIONS OF DENTAL FOCAL INFECTION

CHARLES A. RESCH, D. D. S.

The significance which has been attached to the rôle of dental focal infection in the causation of systemic diseases has led to extremes in its application in many cases, with the result that its importance has been doubted by those practitioners who attempt to justify therapeutic measures by rational rather than by empirical methods. The hypothesis of this interrelationship is complex and a comprehensive knowledge of the physiology and pathology of the body as a whole is essential before the problem may be evaluated properly.

The purpose of this paper is to attempt to correlate the observations which have been made and the present conceptions of the relationship between dental infection and systemic disease. To these will be added the results we have obtained in attempting to apply the observations made by investigators in this field.

The theory and principles of focal infection are not new. Historians record such consideration by the Egyptians some 2600 years ago, and Hippocrates is said to have recommended the removal of decayed teeth for the relief of rheumatism. In 1818 Benjamin Rush[1] of Revolutionary fame, and one of the signers of the Declaration of Independence, reported cases of systemic disease which he ascribed to dental infection and about which he wrote, "I have been made happy by discovering that I have only added to the observations of other physicians in pointing out a connection between the extraction of decayed and diseased teeth and the cure of general diseases . . . When we consider how often the teeth when decayed are exposed to irritation from hot and cold drinks, and ailments from pressure by mastication, and from the cold air, and how intimate the connection of the mouth is with the whole system, I am disposed to believe that they are often the unsuspected causes of general, and particularly nervous diseases . . . I cannot keep from thinking that our success in the treatment of all chronic diseases would be very much promoted by directing our inquiries into the state of the teeth in such people and advising their extraction in every case in which they are decayed. It is not necessary that they should be attended with pain in order to produce diseases." Rush's ideas would have been just as timely a hundred years later, and it is well to remember that he wrote long before the advent of the roentgenogram.

Following Rush, many other eminent clinicians associated dental sepsis with systemic disease. Black[2] states that, as early as 1839, cases of dental diseases that were related to lesions of the eyes were

reported in the literature, and Garretson[3] in 1890 described various systemic derangements, such as spasms, skin diseases, diarrhea, and "irritation," which he ascribed to dental origin.

In 1891, C. W. Miller[4], an outstanding bacteriologist, wrote, "During the past few years the conviction has gradually grown continually stronger among physicians as well as dentists that the human mouth as a gathering place and incubation of diverse pyogenic germs performs the significant rôle in the production of various disorders of the body, and that if many diseases whose origins enveloped in mystery could be traced to this source, they would be found to have originated in the oral cavity."

These early clinicians were limited to clinical observations only, and even without the aid of roentgenograms, they recognized the relationship between abnormal conditions of the mouth and certain systemic conditions. The reason for such an association could be explained only by the direct extension of the infection into the surrounding tissues by way of the blood stream thus producing a septicemia, by the absorption of pus and bacteria through the alimentary system, or through reflex irritations from dental pulps. In 1896, König[5] made demonstrations of dental radiography. Upson[6] in 1909 attempted to establish a relationship between dental lesions and serious mental disturbances. Two years later, Pancoast[7] attempted to establish a relationship between dental effects and idiopathic epilepsy, and Sparrevohn[8] suggested the possibility that impacted third molars might be an etiological factor in the production of Ludwig's angina. This work introduced the era of dental radiography as an aid in diagnosis and it initiated many lines of investigation.

As interest in dental radiography increased and as improvements were made in technic, members of both the medical and dental professions began to place greater emphasis on dental sepsis as a causative focus in systemic infections. This marked the beginning of a broader concept of focal infection, and this was increased by the definite attempts of bacteriologists and other scientists to place the hypothesis on a basis of rational therapeutics rather than on the empirical observations which had prevailed prior to the use of roentgenology and bacteriology. At approximately this time, William Hunter, an eminent English internist, presented a paper at Yale University entitled, "The Rôle of Sepsis and Asepsis in Medicine."[9] In this paper he severely criticized the American dental profession for its part in producing "mausoleums of gold" in the mouths of the American people. He felt that under these "mausoleums" were the ideal culture media for the growth of the particular bacteria associated with the anemias and nephritis. To Hunter, the problem was not one of teeth and conservative dentistry, but of

sepsis and asepsis, with conservative dentistry assuming the rôle of septic dentistry, incubating infection. Needless to say, this paper aroused a storm of protest from the dentists of America, but in the end, it served to stimulate interest in the scientific study of dental sepsis.

Frank Billings[10] and his associates in Chicago published the first truly scientific papers concerning this problem. In 1916, by careful correlation of clinical, bacteriological, and experimental findings, they were able to present some apparently definite facts concerning the relationship of systemic diseases and periapical infections. The more universal use of radiograms for the diagnosis of oral infection was strongly urged. With the inauguration of this method of research, other clinicians entered the field and since that time, the medical profession has led the way, and the dentist has assisted by providing clinical observations and the results of roentgenographic studies. Rosenow and later Haden presented carefully controlled and substantiated experimental work which has made the general acceptance of the hypothesis more secure.

Before discussing the experimental studies on this problem, a definition of the condition should be stated. Billings' early definition of focal infection was simply, "a circumscribed area of infection," but this has been elaborated in the following manner: "focal infection is a chronic process beginning in some epithelial defect and later involving remote parts of the body by establishing new bacterial colonies or by toxemias, and caused chiefly by Streptococci and sometimes Staphylococci." This definition has been formulated by Hatton and his associates[11] of Northwestern University.

Rosenow[12], in a series of experiments, was able to demonstrate that organisms in chronic foci vary greatly in their affinity for different tissues of the body, and he emphasized that a focus is not only an area in which organisms multiply and enter the blood stream, but also a place where tissue affinity is acquired. By studying the migratory movements of bacteria in an electrical field he has since endeavored to determine the reasons for this elective localization.

He found that streptococci from similar sources in patients with different types of disease had a definite variation in cataphoretic time and velocity. Of particular interest were his observations of the shift of the cataphoretic time and velocity of streptococci isolated from the nasopharynges and apices of the teeth of patients suffering from arthritis, encephalitis and other diseases.

However, the question in which the dental practitioner is vitally interested is, how can we demonstrate with the diagnostic means now at hand that dental infection actually exists? The answer simply stated is—such a condition cannot actually be so demonstrated. Rosenow's

work has shown the complexity of the ramifications surrounding the problem. If it were possible to classify the histopathological phase by microscopic study of the tooth in question and to examine the tooth and tissue without sacrificing either, the solution might be obtained.

Haden[13] approached this problem from the bacteriological viewpoint. He attempted to correlate the bacteriological and roentgen findings. He found that in 500 pulpless teeth, which were radiographically negative, 46.2 per cent contained cultures of ten or more colonies. Of 500 pulpless teeth which were roentgenographically positive, 62.8 per cent on culture contained ten or more colonies. In the controls, 400 vital teeth were examined and on culture, but 4.8 per cent had ten or more colonies. Viewing his results from a negative aspect, we find that of the positive pulpless teeth, 26 per cent were negative to bacterial growth in deep agar culture medium. Of the negative pulpless teeth, 44.3 per cent were found to be negative in deep agar culture medium. Of the vital control teeth, 85.5 per cent were found to be negative

In explanation of the 4.8 per cent of the vital teeth in which ten or more colonies were cultured, it is necessary to again refer to Rosenow's work in which cultures of Staphylococcus albus were planted in the anterior vital teeth of dogs. After a period of time, extraction of these vital teeth revealed the presence of the organisms in the pulp canals and at the apices of other nonvital teeth in situ which had not been contaminated experimentally. After a longer period of time, other sound teeth that were removed were found to be sterile, but the nonvital teeth extracted later remained contaminated. From this work it was concluded that all teeth are affected metastatically by bacteria if such bacteria have access to the general circulation. However, vital teeth in general have the power of overcoming invasion, provided the general resistance of the host is normal, while nonvital teeth apparently do not have this ability or resistance and remain as a source of continued infection.

Haden and Rosenow recognize four possible groups of dental focal infection: (1) The positive and negative pulpless tooth with chronic periapical infection, (2) pyorrhea alveolaris and pockets surrounding partially erupted teeth and under poor restorative appliances, (3) chronic pulp infection in vital teeth, and (4) residual alveolar infection following dental extraction.

Rhoads and Dick[14] extracted radiographically negative pulpless teeth from all parts of the mouth and studied them bacteriologically. They concluded that it seemed justifiable to regard all pulpless teeth as probable foci of infection whether or not radiographs showed changes in the apices, and they further emphasized that this is true in the presence of systemic disease of a type which usually is associated with focal infection.

Recently, we had the opportunity of removing two teeth from a hospitalized patient. One was a lower left bicuspid which was devitalized and showed definite evidence of periapical involvement with a large area of rarefaction, and beyond this there was condensing osteitis. The other tooth, which also was devitalized, was an upper left lateral and it was absolutely roentgenographically negative to any apparent periapical pathosis. Both teeth were cultured by our bacteriologist, Mr. Reich, who used a brain agar culture medium and brain broth culture as contrast. Considerably more than two hundred colonies of bacteria grew on the agar culture. The bacteria from both teeth after incubations for 24 hours were later proven to be Streptococcus nonhemolyticus. The profuse growth of a single species of bacterium on agar ruled out contamination. The essential point here was that the removal of the definitely radiographically positive teeth would not have excluded all the possible factors of dental focal infection.

The Northwestern University group[11] recognize the following primary dental foci: (1) The periapical involvement which is primarily of metastatic origin or the result of a bacteremia in which a focus is set up at points of weakest local resistance, (2) pyorrheal infection which is primarily toxic and not a true lateral abscess, but a circumscribed one caused by poor drainage and a low grade chronicity, (3) the pulp infections or a localized abscess in an otherwise normal pulp, which is predominately toxic and is the most potent factor in dental focal infection. In this group, the symptoms of discomfort are present but often referred. Listing the vitality of such a tooth may show a reaction varying from normal to sluggish (hypesthesia) to hypersensitivity. The tooth usually shows a large restoration and in such instances, the radiogram is of little diagnostic value. Pulp stones may be recognized and be the only visual clue roentgenographically. The fourth class recognized by the group at Northwestern is the partially erupted third molar with its recurring pericoronitis and its tendency to become toxic. These workers have studied focal infections not only from the bacteriological standpoint, but also from the histopathological angle and present slides of the microscopic picture found at the apices of these teeth in situ. Areas of periapical rarefaction do not necessarily mean infection. This group has been able to demonstrate areas of rarefaction at the apices of teeth in which there was no round cell infiltration or bacteria.

One particular phase of this type has been investigated by E. C. Stafne[15] who applied the term "periapical osteofibrosis" to the condition, which is the forerunner of the cementoma and is most prevalent in the anterior region of the mandible.

Blayney[16] demonstrated, by microscopic sections of apical tissue, that devitalized teeth with root canals incompletely filled may be entirely free from all indications of inflammation or bacterial invasion. He showed

a carious lower first molar with definite roentgen evidence of periapical involvement around both roots and, histologically, an area of inflammation and destruction of the pulp in the gingival or middle portion of the mesial root. Other microscopic studies of the same tooth showed that the periapical tissues did not show the slightest sign of inflammation or degeneration. His conclusions were that bacteriological study of root ends wherein the inoculum is obtained after extraction is very misleading and that for a reliable study, the material must be collected before the root is disturbed. He also concluded that only roentgenographic evidence of root resorption in the absence of bony changes is not sufficient to justify the extraction of teeth so involved.

In the investigations which we have conducted, we have not had the opportunity to study microscopic sections and have relied on the bacteriological method. Approximately eighty teeth have been cultured, and fifty-seven or 71.3 per cent showed pure cultures of nonhemolytic streptococci; four were of the viridans type. The majority of these teeth were devitalized and there had been some therapy to the root canal. Radiographically negative and positive teeth were present in about equal numbers. Six of the cultured teeth were negative, two having been removed because of peridental involvement. Others gave cultures of streptococci but contamination was apparent because other organisms were reported to be present in the culture. The wide variation in our findings from those of Haden may be explained partially on the basis that our patients were suffering from some systemic disorder and, due to the metastatic nature of organisms and the sites of lowered local resistance, we would expect to find a greater number culturing bacteria.

In the group which we studied there was an upper bicuspid. This was a devitalized tooth, the root canal of which was well filled, and no evidence of periapical involvement was demonstrable roentgenographically. The patient, a young woman, suffered from acute nephritis; some low grade infection was suspected but could not be demonstrated. In the absence of any other etiological factor, the questionable tooth was removed and cultured. The organisms were injected into a rabbit with the result that no demonstrable lesion was found after four days when autopsy was performed. Subsequent reports from the patient, however, have revealed no further recurrence of the systemic symptoms.

In conclusion, since it has been shown bacteriologically and clinically that the teeth and oral sepsis play an important rôle in the general health in the majority of cases, we should attempt to eliminate the practice of extracting teeth that do not appear to be causative factors in the production of systemic dyscrasias. No tooth should be removed on the mere assumption that it is the definite cause of the complaint, because it is a recognized fact that the products of such teeth may act as sensitiz-

ing agents and, therefore, should be considered a secondary rather than a primary cause. Indeed, I feel safe in regarding the majority of infectious teeth in this light rather than as etiological factors. However meager may be our total means of evaluating such conditions, the application of "snap diagnosis" is to be less condoned than extolled as a sensible economy. The most thorough diagnostic studies at our command must be employed. From the dental standpoint, these include a history of dental discomfort, a complete digital examination of the mouth including a test of the vitality of the teeth, and a complete roentgen examination. Roentgen examination of two suspicious looking teeth for the purpose of determining the general condition is inexcusable from the standpoint of conscientious and thorough practice and is usually worthless from an economic viewpoint. If, after a complete survey, there is evidence of abnormality of the oral structures, the age, the position of the tooth and its proximity to important structures, the condition of the tooth, the importance the patient attaches to his teeth as to care and condition of the mouth, and finally the general complaint of the patient in addition to evidence of low grade infection, determine whether a suspicious tooth should be extracted. It is in such problems that dentistry and medicine merge, and only after the fullest coöperation between both professions does the final therapeutic result justify the measures attempted. In dealing with these problems, it is not entirely a question of how much infection is present, but how well can we ascertain that such conditions exist. Unless a complete understanding of the condition can be procured before the teeth are condemned, many normal teeth will be sacrificed and even with all due caution, teeth that may be causing no trouble will be removed, but this number will become smaller with continued observation, study, and more complete records.

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THE SIGNIFICANCE OF CHRONIC HOARSENESS IN ADULTS

JUSTIN M. WAUGH, M. D.

Pain, bodily discomfort, shortness of breath, an overactive heart, swelling of the extremities, chronic fatigue, some form of indigestion, or any symptom or group of symptoms that restrict the normal activities of human beings constitute the chief complaints of patients seeking relief from their medical advisors. Such symptoms always elicit a careful, painstaking examination; on the other hand, the symptom of chronic hoarseness is a very common complaint, but its significance is greatly underestimated by the average practicing physician.

How is the patient who presents himself for the relief of persistent and increasing hoarseness customarily managed? Inquiry is made concerning the general health, the duration of the symptom, and whether the patient has any cough or pain. The patient replies that nothing seems to be wrong except that his voice is not clear and that he has to make a constant effort to speak, whereas formerly he was never conscious of discomfort or of inconvenience. The doctor then takes a tongue spatula and looks into the patient's throat. What does he see? Nothing but a normal or slightly congested throat. He may look carefully at the tonsils, and sometimes he may see what he regards as a possible cause of hoarseness. But the infallible prescription is a gargle or a favorite medicine for colds. Thus the consultation terminates and the patient goes on—sometimes to certain, slow decline and death, just because the doctor was not aware of the many pathological conditions which might be the cause of the hoarseness and not sufficiently interested to direct his patient to someone who could give him assistance in making an accurate diagnosis.

Think of the position of the larynx, or voice-box, in relation to the tongue and the back of the pharynx. Recall what happens if one gets a few drops of fluid into the larynx, and then ask—why a gargle? In using a gargle, the muscular action of the throat combined with closure of the epiglottis is directed entirely to holding the solution above the level of the larynx, and it practically always succeeds in doing this. But even if the fluid reached the uppermost part of the larynx, it would still not reach the vocal apparatus, which is some distance below the upper margin of the larynx, and if the pathological condition were at a level just below the cords, how utterly futile would be the use of a gargle. The thyroid, cricoid, and arytenoid cartilages constitute the so-called voice-box which contains those muscular, cartilaginous, nervous, and circulatory elements that are necessary to produce tone and speech and which have a very vital relationship to respiration. Within this small space may develop a large variety of pathological conditions, and these may either be limited to this territory alone or become second-

ary to extensive pathology in contiguous structures. It would be difficult to find anywhere in the body a region of equal dimensions in which such a variety of pathological conditions may exist. Moreover, when the dimensions of the human larynx and its interior structure are considered, it is quite understandable that a very slight pathological change can easily derange this function of voice production. Thus, chronic congestion of the cords or of the mucous membranes will produce hoarseness; ulceration will produce hoarseness; granulomata, hoarseness; new growths, hoarseness; impairment of the nerve supply to the vocal cords, hoarseness.

The first symptom of which the patient is conscious in any of the above conditions is hoarseness, though how soon the hoarseness will develop after the onset of the disturbance will depend to some extent upon the location of the pathological area.

Paralysis of the Vocal Cords

Paralysis of one or both vocal cords may be due to disease of the central nervous system, the most common cause being syphilis. The paralysis is usually bilateral. The abductor power is lost early but the adductor function remains unaffected for a long period of time. The voice is retained for many months but dyspnea is progressive.

Hemorrhage, new growths, or degenerative disease, occurring in the nucelus ambiguus, in the floor of the fourth ventricle, or at the jugular foramen, may give rise to the jugular syndrome which causes peripheral manifestations in the form of paralysis of the soft palate and of the muscles of the pharynx and larynx on the corresponding side. If the lesion is peripheral in origin, it is usually unilateral (Fig. 1, A and B) and is due to trauma or to pathology in the chest which causes pressure on the recurrent laryngeal nerve. Many pathological changes may occur within the neck and chest cavity which will cause pressure on the recurrent nerves with consequent impairment of the function of one vocal cord. Thus tuberculosis, aneurysm of the aorta, new growths, and changes in the mediastinal glands may be the cause of the paralysis. Prominent among the lesions that produce early paralysis of one vocal cord is cancer of the esophagus. Paralysis may also occur as the result of pressure from an esophageal diverticulum when it is filled. There may be no pain or difficulty in swallowing—merely a hoarseness due to the paralysis of the vocal cord from pressure upon the recurrent nerve on the same side.

Recently we have observed two cases of unilateral vocal cord paralysis caused by pressure or stretching. In the one case there was unusual stretching of the seventh, eighth, ninth, tenth, and eleventh nerves due to a bilateral acoustic tumor. Following operation, the function of these nerves has almost completely recovered, except for the seventh.

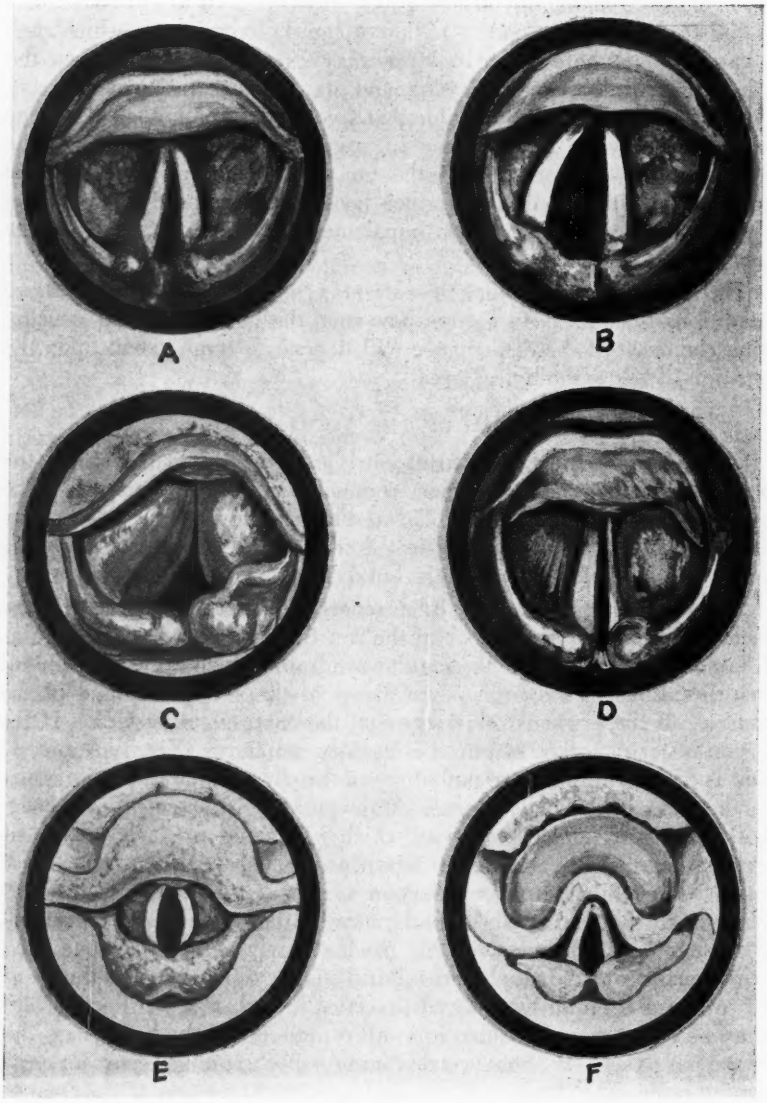

FIGURE 1: A. Unilateral paralysis of left vocal cord. Left cord fixed near midline. B. Unilateral paralysis of left vocal cord. Left cord fixed in midline; right cord in full abduction. C. Trauma to larynx with hemorrhage into arytenoids and both false cords. D. Unilateral hemorrhage with extravasation of blood into larynx. E. Tuberculosis of larynx. F. Tuberculosis of larynx.

In the second case the pressure was caused by a paragangliomatous tumor of the cervical sympathetic lying above the bifurcation of the carotid artery. The paralysis was not relieved following operation although the tenth nerve was not severed.

Injuries to the Larynx

While injuries to the larynx (Fig. 1, C and D) are relatively rare, due to the mobility of the larynx together with the protection offered by the lower mandible, the treatment of fractures, wounds, and burns requires skill, presence of mind, and willingness to act on the part of the surgeon.

In cases of some sudden injury to the larynx a marked *concussion* of the larynx may ensue which causes dyspnea, syncope, and death. Artificial respiration and immediate tracheotomy are indicated.

Fractures usually occur in men and they may be so slight as to go unrecognized. Gunshot wounds in reality are compound fractures, and structures other than the cartilages may be involved such as the thyroid, the vocal cords, the vagus nerve or its branches, the great vessels of the neck, the hyoid bone, and the mandible. There follows, therefore, great danger from cellulitis, emphysema, and mediastinitis. Pneumonia may follow. Sometimes secondary hemorrhage and subsequent stenosis of the larynx or trachea result. Hoarseness begins at once and is quite persistent.

Incised wounds of the larynx are usually the result of murder or attempted suicide. An increasing number of these cases are now seen due to automobile accidents. Various degrees of hoarseness accompany these wounds and may persist indefinitely.

Burns may result from fire, acids, or from injudicious or overenthusiastic use of radium or x-ray. These always heal slowly and the stenosis which follows may reach any degree, even to extensive destruction of the larynx. The temporary or chronic edema following burns calls for great wisdom in treatment. The slowly healing ulcerated surface should never be swabbed; tracheotomy may be necessary at any time. Perichondritis and necrosis may follow weeks or even months after severe burns. This is particularly true of burns due to x-ray or radium. Any degree of chronic hoarseness may result from burns to the larynx.

Tuberculosis of the Larynx

Tuberculosis takes on an added virulence when it attacks structures near the exterior of the body. Involvement of the larynx materially diminishes the outlook for the patient's recovery. The pulmonary process may not have been sufficiently active to cause the patient any concern and the invasion of the larnyx may be very subtle. Since it is quite impossible to detect a so-called "pretuberculous stage" of laryngeal tuberculosis, an early diagnosis of the cause of hoarseness is of

vital importance. Tuberculosis is usually not primary in the larynx, and many clinicians think that it is always a secondary or complicating manifestation. If, however, the laryngeal lesion is recognized and no lesion has been demonstrated in the lungs, it means that the pulmonary tissues are seriously threatened and the pulmonary disease will manifest itself soon. In such a case, a roentgen examination of the chest will almost always demonstrate lung involvement.

The usual site of primary invasion of the larynx by tuberculosis is in the arytenoid and interarytenoid areas. The mucosa is involved but the epithelial cells remain intact. The original deposit is in the form of multiple tubercles which later coalesce and break down, leading to ulceration. The invasion of the walls of the small veins causes a damming-back of the circulation and gives the appearance of edema of the tissues. In the early stages (Fig. 1, E), this tumefaction occurs in a localized area, but later it appears to be asymmetrical edema of the arytenoid area. Involvement of the epiglottis appears later. The area affected presents a pale, dull gray appearance with a slightly yellowish tinge. The epithelial surface is unbroken and at times the individual tubercles may be seen plainly beneath it.

Should there be involvement of the epiglottis, the first change from the normal is a unilateral thickening over or near the free edge, although sometimes it may occur near the base. It is distinctly more red, not well defined, and at this stage not edematous. Later, edema occurs over the entire free edge and this gives the so-called turban-like appearance of the epiglottis (Fig. 1, F).

Among the early symptoms may be noted recurrent aphonia. Dysphonia is more apt to occur if there is much thickening in the arytenoid areas. Cough is a much more prominent symptom when ulceration occurs in the posterior commissure than when the disease is in other parts of the larynx. Pain, a later symptom, means ulceration and is experienced either at the site of the area involved or is referred to the ear. Ulceration of the epiglottis or over the arytenoid area makes swallowing very painful; in fact, it is at times almost unbearable and requires injection of the superior laryngeal nerve or its section to give relief. Otherwise the patient becomes rapidly dehydrated, and proper nutrition becomes impossible. When there is extensive edema of the larynx, we have found tracheotomy a very satisfactory measure as this not only relieves dyspnea but puts the larynx at absolute rest. The management of these patients in a sanatorium is usually much more satisfactory than in a home. In such institutions, the larynx is usually under constant observation and treatment is instituted if necessary. Unskillful attempts at direct medication of the larynx are strictly contraindicated.

In any case of tuberculosis of the chest, chronic laryngitis may be

found which is not necessarily due to tuberculous involvement of the larynx. The important observation is whether or not the lesion in the larynx is symmetrical, for the lesion of chronic laryngitis is always symmetrical, whereas a unilateral or asymmetrical involvement, especially in the posterior part of the larynx, is very suggestive of tuberculosis. When this swelling occurs in the interarytenoid area, this is also an important factor in making the diagnosis. It is sometimes necessary to examine the patient in what is known as the Killian position, as this brings into view the posterior surface of the interarytenoid area, and one may see very early ulceration or granulation on the posterior surface of a mass which, if viewed from the anterior aspect, presents a smooth, nonulcerated surface. The color of the mucous membranes is not of aid in the differential diagnosis between early tuberculosis and chronic laryngitis. It is important to remember that although the earliest manifestation of tuberculous laryngitis occurs in the vocal cords, especially in their posterior third, nevertheless the cord retains its motility and there is no infiltration and fixation such as is seen in the presence of malignancy. Figure 2,A shows extensive tuberculosis of the throat and larynx.

Syphilis of the Larynx

All stages of syphilis have been demonstrated in the larynx. At times it may be difficult to make a diagnosis of syphilis of the larynx, but this condition has certain rather characteristic appearances. The involvement is usually extensive and it is of the infiltrating type. It has been described accurately by Bosworth as causing a "peculiar, dusky, sombre hue of the mucous membrane which has a dark red, or somewhat purplish tint, in contrast to the bright red, scarlet color of an idiopathic inflammation. It may be intensified in certain areas, thus giving the tissues a mottled appearance."

Tertiary lesions in the larynx usually appear in the form of a gummatous tumor. However, due to the activity of the larynx, these gummata break down and ulcerate very early. The ulceration is deep and crater-like, with sharp-cut edges, in which respect it differs sharply from tuberculous and malignant ulcerations. Though improvement in the patient's general condition takes place during the course of treatment, the ulceration tends to recur. It may be localized in any part of the organ and the cicatrization that follows ulceration may produce great distortion of the larynx with persistent hoarseness.

Blastomycosis of the Larynx

Among other diseases that may cause gradual and chronic hoarseness is blastomycosis of the larynx which is usually associated with lesions in the pharynx, trachea, and lungs. The histological picture is sug-

gestive of tuberculosis as there is evidence of inflammatory disease and giant cell proliferation of epithelium with minute abscesses.

The characteristic feature of blastomycosis is the presence of spherical, encapsulated, parasitic cells, the presence of which can best be demonstrated in unstained specimens of the secretion. A "cold in the throat" is usually the first symptom and this is followed by persistent and increasing hoarseness; gradual stenosis, cough, and dysphagia may develop.

In the early stage of the disease, flat lesions are seen on the larynx. These nodules are minute, superficial abscesses and there is an opaline frog-spawn secretion. The appearance of the tiny nodules is characteristic of the disease.

Diagnosis is made only by biopsy and bacteriological examination. The intensely red and inflammatory appearance of the larynx as seen in the mirror is not typical of tuberculosis and is particularly not suggestive of carcinoma. If this condition is not recognized and treated, the outcome is fatal. Potassium iodide is the treatment of choice.

Benign Growths of the Larynx

Almost any form of benign growth (Fig. 2, C and D) may make its appearance in the larynx, but those most commonly seen belong to the following groups: (1) The papillomata (Fig. 2, E and F); (2) the fibromata; (3) the cystomata, and (4) the angiomata. These growths usually involve the margins of the cords, and though small, may produce a marked impairment of the voice without causing other symptoms. They may be present for years without showing any tendency to malignant degeneration. Usually they can be removed successfully without injury to the vocal structures and the hoarseness and voice disturbances may be completely relieved.

Malignant Growth of the Larynx

Cancer of the larynx (Fig. 3, A, B, C, D) begins insidiously and in its early stages progresses slowly. It may be a carcinoma of the basal-cell or squamous-cell type. Its usual site is on one cord at about the junction of the anterior and middle thirds. It tends to progress in the direction of the long axis of the cord, and until well advanced does not involve the other structures within the larynx. Because of the sparsity of the lymphatics, it does not readily become extrinsic, that is, it does not spread outside the laryngeal box.

The usual site of the initial lesion is on the free edge of one vocal cord. This free edge has no true mucous membrane covering, there being only a firm thin layer of epithelium and no glands. From this area the lymph flow is to two nodes, one on each side, and from these nodes there is no demonstrable efferent lymph flow. This fact misleads

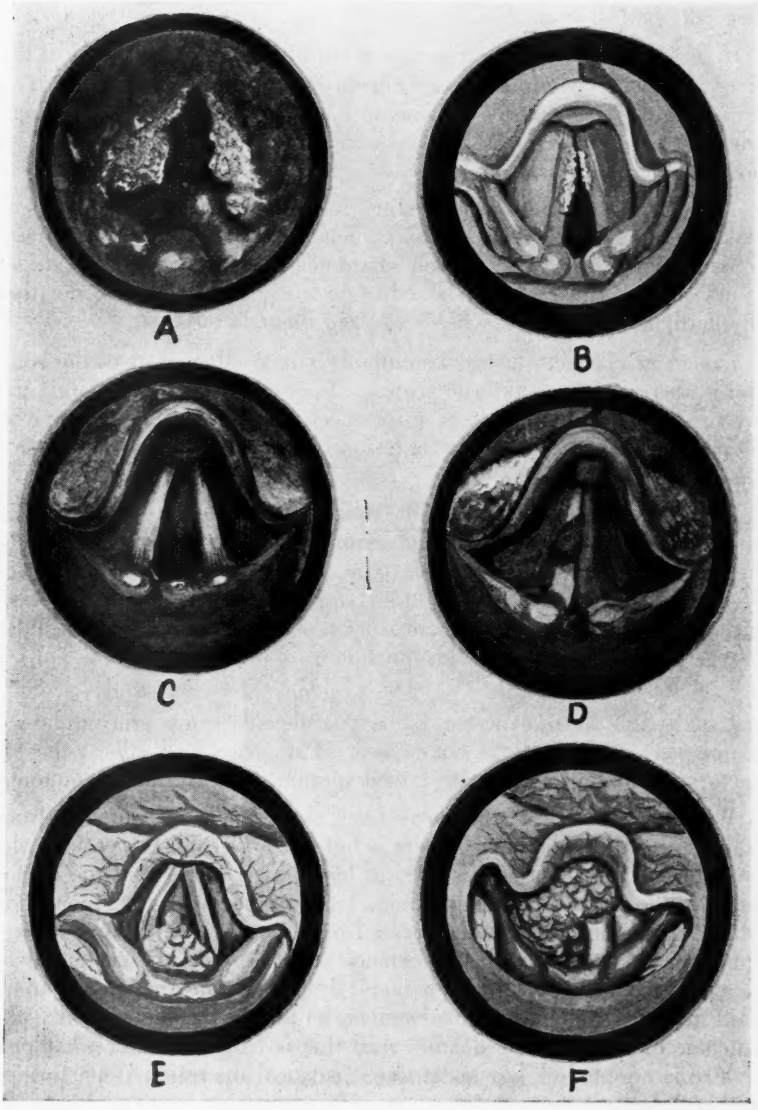

FIGURE 2: A. Extensive tuberculosis of throat and larynx. B. Keratosis of larynx. C. Tumor of larynx. Appearance of growth on respiration. D. Tumor of larynx. Appearance of growth on phonation. E. Papilloma of larynx. F. Papilloma of larynx.

the doctor because the lesion does not progress rapidly and precious time may be lost.

If, however, the lesion begins in one cord in the posterior third of the larynx, it is very significant as the growth is probably subglottic at an early stage. This type of carcinoma has the appearance of a benign growth and often the portion recovered at biopsy fails to show its carcinomatous character.

There is also a group of borderline cases which begin as keratoses or leukoplakias (Fig. 2, B). For many months or even years they remain nonmalignant but, at times, their character may change as the patient grows older. These patients should be seen periodically in order that any malignant change may be recognized immediately.

Cancer rarely metastasizes from the larynx to other parts of the body and is also rarely a metastatic growth. It is usually primary within the larynx, though in extremely rare instances cases have been observed in which it appeared as a metastatic lesion from a primary cancer in some other part of the body.

Cancer of the larynx may be due to direct extension from a cancer in an adjacent structure, such as the esophagus or the thyroid gland. In such a case it is of the extrinsic type. The extrinsic type of cancer progresses much more rapidly, the lymphatic structures are involved early, and glandular enlargement is soon evident. This type is usually of the squamous-cell type and is much more rapidly fatal than the basal-cell intrinsic cancer.

Usually in cases of cancer of the larynx the only symptom complained of for weeks or months is hoarseness. Pain, cough, dyspnea, the expectoration of foul and blood-stained sputum, etc., are later symptoms.

Why then, in view of the above facts, do we have so many fatalities from cancer of the larynx? There is but one answer: The patient who is suffering from hoarseness goes to his family doctor and the doctor belittles the gravity of the symptom. He temporizes with a condition which, if diagnosed early and treated intelligently, offers every chance for cure. If one waits for the textbook series of classical symptoms of cancer of the larynx to appear, namely, dyspnea, hemorrhage, salivation, pain in the ear, glandular involvement, and cachexia, there is only one outcome of the disease—death. And this is true no matter what procedure is adopted or how extensive a surgical operation is performed at this stage.

One should never be misled by the patient's general condition, especially in the first and second stages of laryngeal cancer. He may retain his weight and vitality; he may feel well, and may be annoyed only by slight, persistent hoarseness. Neither should one be misled by the

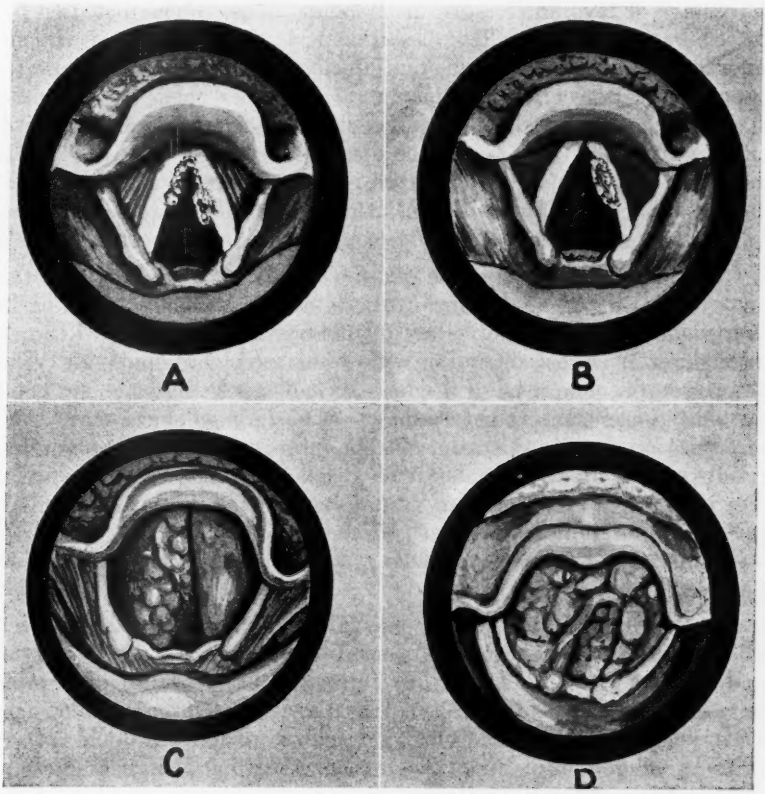

FIGURE 3: A. Carcinoma of larynx. B. Carcinoma of larynx. C. Advanced carcinoma of larynx. D. Advanced carcinoma of larynx.

fact that in the early stages of the disease the use of iodides sometimes mitigates the severity of the symptoms.

In the great majority of cases of cancer of the larynx, a definite diagnosis is not made until many months have elapsed. To make that diagnosis requires painstaking effort and repeated observation. Complete cocainization of the throat is often necessary to secure a view of the larynx in a sensitive or refractory patient.

Biopsy is frequently of great importance in establishing the diagnosis, but this should be done only with the distinct understanding with the patient that if a pathological diagnosis of cancer is made, operation is to follow immediately.

As long as the lesion is unilateral and intrinsic, a skillfully performed laryngofissure will probably result in cure. But, to secure the highest

percentage of favorable results the technique must follow that used by Dr. Chevalier Jackson. The dissection beneath the cartilage without entering the cavity of the larynx until the last step of the operation is all-important in preventing transplantation of cancer cells. To do this, the opening of the cartilaginous box must be made from without inward and the laryngeal scissors must be dispensed with. This is the key to the whole operation, and yet today it is often ignored. If the lesion is unilateral but subglottic or if it has extended anteriorly around the commissure to the opposite side, laryngectomy should be performed.

Only two groups of men are qualified to do laryngectomy. In the one group is the general surgeon who is willing to interest himself in every minute and delicate feature of this operation and who will work throughout in close coöperation with a competent laryngologist. The other group is comprised of the few laryngologists who have had good training in neck surgery before they became laryngologists. Any general surgeon can rip out a larynx but his percentage of unfavorable results will be high. Most laryngologists are surgical scratchers when they undertake to remove a larynx and the time and trauma involved go far toward prejudicing recovery of the patient. In every case conscientious after-care by both the surgical and nursing staffs is all-important.

In conclusion, let me emphasize again the following points: Keep in mind the variety of pathological conditions that may affect the larynx and remember the importance of ferreting out the cause of chronic hoarseness in every adult, especially if he is over forty years of age. Have your opinion checked closely whenever you are in doubt. Bear in mind the dictum of Sir St. Clair Thompson that if in a case of intrinsic cancer of the larynx the patient's general health is good and the diagnosis is made early, the prognosis for lasting cure is better than in the case of cancer in any other part of the body.

CYSTS AND SINUSES OF THE NECK*

EUGENE A. GASTON, M.D.

Cysts and sinuses of the neck may be roughly classified into those which occupy the midline and those which lie lateral to the midline. This discussion deals with cysts and sinuses lying in both locations but is limited to those which arise from the deeper-lying embryologic structures. Thus dermoids, simple retention cysts of the skin, etc., have been excluded except as they are involved in the differential diagnosis.

The nomenclature of the subject is in a rather chaotic state. There is considerable evidence to show that not only do the so-called "branchiogenic" or "branchial" cysts and fistulae fail to arise from the branchial apparatus but that, in like manner, the "thyroglossal" cysts and sinuses do not arise directly from the thyroglossal apparatus. Because the terms "branchial" and "thyroglossal" have become so ingrained in the literature, they have been retained in this discussion and used synonymously with the simpler terms "lateral" and "median" respectively.

PART I

BRANCHIAL CYSTS AND FISTULAE

Etiology and Embryology: In the human embryo, the branchial apparatus is a very transitory structure which is first evident during the latter half of the first month of intra-uterine life and has completely disappeared by the end of the second month. This apparatus arises in the region of the neck and consists of five or six bars or arches separated by corresponding depressions or grooves. The arches are termed the branchial or visceral arches and the intervening depressions, as viewed from the outside, are called the branchial grooves. Similarly the lining of the pharynx, as viewed from the inside, is thrown into elevations by the depth of the branchial arches and these depressions between the arches are spoken of as the pharyngeal pouches. On the outside the arches are covered with ectoderm while on the inside the covering is entodermal in origin. Mesoderm separates entoderm from ectoderm, and, in the regions where the branchial clefts meet the pharyngeal pouches, this mesodermal separation is very thin. In gill-bearing animals the ectoderm and entoderm disappear at this point of apposition to form the gill slits.

Most writers are in agreement regarding the ultimate disposal of the components of the branchial apparatus in normal development. The first arch is larger than the others and divides into upper and lower portions. The upper portion forms the upper lip and a portion of the maxilla and side of the cheek. The lower portion forms the lower lip and a portion

*Abstract of Fellowship Thesis which was awarded the William E. Lower Fellowship Thesis Prize for 1936.

of the mandible, the body of the tongue, and the muscles of mastication. From the first branchial cleft comes the external auditory canal and the lobe of the ear; the first pharyngeal pouch gives rise to the eustachian tube and the tympanic cavity. The tympanic membrane is the remnant of the first gill membrane, that point of apposition of ectoderm and entoderm where the first branchial cleft meets the first pharyngeal pouch.

The second branchial arch gives rise to the lesser cornu of the hyoid bone, the styloid process, which fuses with the temporal bone, and the intervening stylohyoid ligament. From it also develop muscles of the anterior portion of the base of the tongue and the arcus palatoglossus. No traces of the second, third, or fourth branchial clefts persist. The second pharyngeal pouch develops into the sinus tonsillaris and the tonsil.

The third arch gives rise to the greater cornu and body of the hyoid bone, the stylopharyngeus muscle, and some of the muscles making up the soft palate. The corresponding pharyngeal pouch gives rise to the thymus, a structure of great importance to the present consideration.

The ultimate destination of the fourth, fifth, and sixth arches is not definitely known nor is it of great importance to this discussion. In general these arches make up the soft parts in the region of the greater cornu of the hyoid bone. The fourth pharyngeal pouches give rise to the lateral lobes of the thyroid gland.

Most authorities today subscribe to Wenglowski's[1] theory that lateral cervical cysts and fistulae arise from remnants of the embryologic thymic duct. This structure is first visible in the 6.5 mm. embryo where it may be seen as a tube-like structure with a definite lumen descending from the third pharyngeal pouch on each side. It then descends laterally to the anlagen of the lateral thyroid lobes to a point near the lower border of the latter where the structure changes from that of a tube to that of a solid, gland-like organ (Figs. 1 and 2). Concomitant with this caudalward progression, the tube-like prolongation extending from the third pharyngeal pouch retrogresses and eventually disappears in an orderly fashion from above downward.

"If the thymus anlage did not retrogress it would go from the pharynx laterally and slightly downward to the area between the angle of the jaw and the ear lobe. From here it passes downward, forward and medially, lying close to the lateral border of the thyroid gland and medial to the anterior border of the sternomastoid muscle, down to the sternum where it passes into the actual gland substance."[2] Because this so accurately describes the course actually taken by lateral cervical fistulae, Wenglowski[1] concluded that remnants of the tubular thymus anlage actually comprise the lateral cervical fistula. As further evidence that these pathological entities do not arise from the branchial

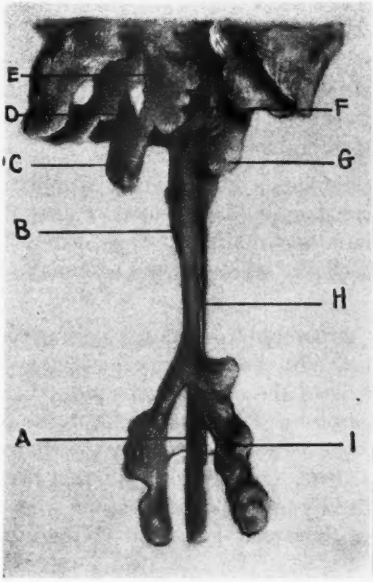

FIGURE 1: Esophageal lumen and branchial apparatus of 6.5 mm. embryo. A. esophagus; B. trachea; C. lateral thyroid lobes; D. thymus anlage; E. midthyroid anlage; F. thymus anlage; G. lateral thyroid anlage; H. esophagus; I. left lung anlage. (Redrawn after Wenglowski[1]).

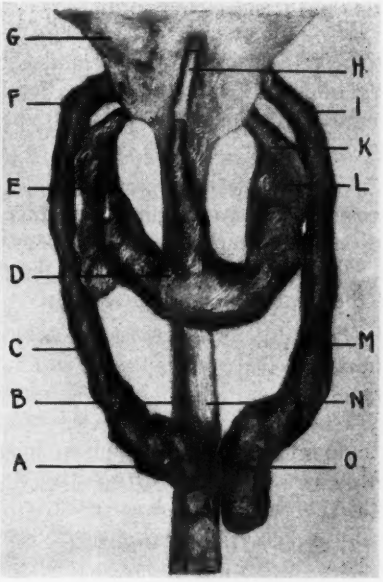

FIGURE 2: Pharynx, esophagus, trachea, and organs developing from them in a 14 mm. embryo. A. thymus; B. esophagus; C. thymus duct; D. midthyroid lobe; E. lateral thyroid lobe; F. thymus duct; G. pharynx; H. thyroglossal tract; I. thymus duct; K. lateral thyroid lobe duct; L. lateral thyroid lobe; M. thymus lobe; N. trachea; O. thymus. (Redrawn after Wenglowski[1]).

apparatus proper, he pointed out that remnants of the latter could not exist below the level of the hyoid bone, a point which no present day authority disputes. Against this theory is the fact that not infrequently a lateral cervical fistula opens internally in the supratonsillar fossa which, as we have seen, arises from the second pharyngeal pouch.

Accepting Wenglowski's theory, it is evident that complete lateral cervical fistulae, (i. e., a patent sinus connecting internal and external openings) are a remnant of the thymic duct per se. Cysts in this region arise from remnants of the midportion of the duct where there is no avenue for the products of epithelial metabolism to escape into the pharynx or externally. Incomplete fistulae with internal openings only are rare and are a remnant of the upper portion of the duct. Fistulae with external openings only arise from the surgical or, less frequently, the spontaneous rupture of a preëxisting cyst.

Clinical Aspects

Incidence: At the Cleveland Clinic the diagnosis of branchiogenic cyst or fistula has been made a total of eighty-nine times, an incidence in this institution of less than 0.05 per cent. The incidence in the population at large must, of course, be considerably less than this.

Pathology: These embryological remnants give rise to symptoms because they are made up of misplaced epithelium which retains its capacity to form the products of epithelial metabolism. These products are the content of the cysts and the discharge which proves so annoying to the patient with an open sinus.

The epithelium may vary in its structure from that of stratified squamous to transitional or columnar. In the majority of instances where the epithelium is columnar, it is of the ciliated variety. Wenglowski was able to explain this variation by showing that the lining of the thymic duct varies from squamous at its upper extremity to ciliated columnar at its lower extremity. It is true, as a general rule, that cysts placed high in the neck are usually lined by squamous epithelium whereas those low in the neck are very often lined with columnar epithelium.

The epithelium, regardless of its type, is surrounded by a layer of fairly dense fibrous tissue which usually contains lymphoid follicles in great abundance. The presence of these lymphoid follicles is such a constant finding that it is of considerable importance in establishing a diagnosis microscopically.

Like all embryological remnants, these cysts and fistulae are subject to certain pathological processes which are not peculiar to themselves but may also affect normal tissues. Chief among these is infection which may be either acute or chronic. The acute suppuration of a lateral cervical cyst not infrequently follows an acute infection of the upper respiratory tract, probably as a result of drainage into the lymphatics that abound in the cyst wall. The acute suppuration may point and rupture spontaneously, following which the infection may subside or become chronic. In the latter instance the resulting sinus may continue to discharge intermittently for years. In rare instances the cyst or sinus may be the site of a tuberculous infection as was true in one patient operated upon at this clinic. When infection has been present for a long time, there frequently is no trace of an epithelial lining. It is interesting to note that these embryological remnants are but rarely the sites of malignant degeneration.[3]

Clinical features: The following study was made on a series of twenty-nine cases of lateral cervical cyst and four cases of lateral cervical fistula in which operation was performed at the Cleveland Clinic. In general the findings agree with similar studies reported in the literature.

Cysts: The average age of the patients operated upon was 40.5 years; the youngest was 15 and the eldest 65. The sexes were equally divided —15 men and 14 women. The average duration of symptoms before the patient was seen was 3.7 years, the longest duration 20 years.

In the majority of instances the patient first consulted a physician because of a painless swelling of the neck. Since the swelling usually is painless, the tumor often reaches a considerable size before the patient is aware of its presence. In this series the size of the tumor was described as varying from that of an olive to that of a large orange. In four cases the onset followed an acute infection of the upper respiratory tract.

On examination the tumor usually was described as being cystic or fluctuant but in rare instances it was so tense that its cystic nature was overlooked. In twenty-one of the twenty-nine cases the tumor was located between the angle of the jaw and the mastoid process at or just under the medial edge of the sternomastoid muscle. In three cases, the tumor was found at the level of the hyoid while in five cases the position was not accurately described. The cysts were evenly divided between the two sides, fifteen on the right and fourteen on the left. An internal opening was seen in but one case and that was described as being "low in the pharynx."

Surgery had been employed previously in four of the cases. In each instance, simple incision had been made which resulted in a period of drainage, following which the cyst refilled. On the basis of a mistaken diagnosis one patient was given a course of deep x-ray therapy without relief.

Of the twenty-nine patients operated upon, one postoperative death occurred, a mortality of 3.4 per cent. Follow-up data of one year or more are available for twelve patients (41 per cent), and none of these has had a recurrence of the cyst or drainage from a cervical sinus.

Sinuses: Four patients, all of whom were women, have been operated upon for lateral cervical fistula. The average age was 18 years; the youngest was 8 and the eldest 27 years. One sinus had been present since infancy and the ages of onset of symptoms in two of the remaining three patients were 6 and 19 years respectively. All patients gave a history of having had a cyst previously which either had ruptured spontaneously or been incised surgically. An internal opening was present in but one case and this was in the supratonsillar fossa.

The external opening in each case was along the medial border of the sternomastoid muscle. In one case it was at the level of the cricoid cartilage; in two it occurred at the level of the sternoclavicular articulation, and the level was not stated in one instance.

At operation it was possible to trace the sinus tract to the pharyngeal wall in every case. In all but one of the cases, this occurred at a point low in the pharynx, definitely below the level of the tonsillar fossa.

Follow-up studies are available in two of the four cases. Both these patients have remained free from symptoms for an average of 8 years since the operation.

Diagnosis: Lateral cervical fistulae usually present little difficulty in diagnosis. The location, as emphasized above, is typical while the presence of an internal opening establishes the diagnosis. Fistulae without internal openings may be distinguished from tuberculous sinuses by the history of a preceding cyst which has been drained surgically or has ruptured spontaneously as a result of secondary infection. Very rarely is more than one external opening present whereas the scrofulous sinus frequently has many. The presence of tuberculous disease elsewhere in the body, of course, favors the diagnosis of scrofula.

In making a diagnosis of branchial cyst one should keep in mind that this is a smooth cystic tumor which bears a constant relationship to the sternomastoid muscle; it is usually fixed to the underlying tissues but, in the absence of acute inflammatory change, is never fixed to the overlying skin.

Branchial cysts are most frequently confused with broken-down tuberculous glands, as was the case in four patients operated upon at this clinic. In making a differential diagnosis between the two conditions, the complete absence of cervical adenitis favors the diagnosis of the former while the presence of tuberculosis elsewhere in the body favors the diagnosis of the latter. Furthermore it is unlikely that a tuberculous abscess would exist for several years without becoming attached to the overlying skin. The fact that the contents of tuberculous abscesses and branchial cysts are quite similar on gross examination while, with ordinary culture methods, both are sterile are factors which tend to confuse the picture. The presence of cholesterin crystals in the fluid removed from the cyst is evidence on which a positive diagnosis can frequently be made.

Simple dermoid cysts of the neck occur infrequently. Usually they are more superficial than branchial cysts, and the presence of hair as well as the lack of any especial attachment to the lateral pharyngeal wall makes their diagnosis at operation comparatively easy. Fortunately it is rarely necessary to make a careful distinction between the two before operation, since adequate operative removal is essential in either case.

Cystic hygroma of the neck presents a loculated cystic tumor of very soft consistency which usually can be transilluminated with light. Branchial cysts can never be transilluminated. The occurrence of cystic hygroma in early childhood is a further differentiating point.

Deep seated venous hemangioma of the neck may be distinguished by the "sign of emptying,"[4] i. e., pressure on one portion of the tumor mass causes the fluid to be translocated into another portion.

Lipoma is easily distinguished by its consistency and by the negative results of aspiration.

Malignant neoplasms of the neck, both primary and secondary, are occasionally subject to cystic degeneration. In the case of primary growths the diagnosis must often be made from a biopsy specimen removed at operation. In secondary growths the discovery of a primary site of the disease will establish the diagnosis.

Thyroglossal cysts and fistulae are readily distinguished by the fact that they occur in the midline. Their attachment to the hyoid causes them to change position with deglutition.

Treatment: The treatment of branchial cysts and sinuses is entirely surgical and involves the complete extirpation of all epithelial bearing tissue. The fistulous tract must be carefully dissected down to the lateral wall of the pharynx and amputated. In our experience it has not been necessary to invert the stump of the fistula into the cavity of the pharynx. In the case of branchial cyst a careful search must be made at the time of operation for a strand of epithelial-bearing tissue connecting the cyst to the pharynx. If such a strand is allowed to remain, a recurrence of the cyst is possible.

Part II

Thyroglossal Cysts and Sinuses

Incidence: At the Cleveland Clinic the diagnosis of thyroglossal cyst or sinus has been made 130 times, an incidence of 0.07 per cent. In this series sixty operations were performed. The results of a clinical study of these sixty cases are presented.

Etiology and Embryology: Thyroglossal cysts and fistulae result from a defect in the development of the thyroid gland, which has three points of origin, two lateral and one medial, which give rise to the corresponding lobes. The lateral lobes develop as prolongations from the fourth pharyngeal pouches. These prolongations grow downward and medially to join the anlage of the median lobe (Fig. 2). Development of the lateral anlagen is first evident in the 6.5 mm. embryo. As downward growth proceeds, the pharyngeal or upper portion of the anlage atrophies and, at the 16 mm. stage, the lateral lobes have no connection with the pharynx.

The median thyroid anlage, with which we are most concerned here, begins in the fourth week of embryonic life at a point between the first

and second branchial arches near the tuberculum impar which, in the adult, is marked by the foramen caecum of the tongue. His[5] called this median thyroid anlage the "thyroglossal duct," believing that it had a lumen and that it was directly responsible for the formation of these midline cysts. Wenglowski[1], however, showed this tract to be a solid down-growth of cells which never exhibits a lumen. He presented adequate evidence to show that the midline cysts associated with the thyroglossal tract are the result of proliferation and secretion of epithelial cells carried from the oral epithelium into the mesenchyme of the neck by the rapid descent of the thyroglossal tract. Cysts arise from the misplaced oral epithelium because these cells retain their embryonic properties of developing as oral epithelium and of forming a secreting surface which, surrounded on all sides by connective tissue, give rise to a cyst for lack of a means of drainage. Sinuses arise by the spontaneous or surgical opening of such cysts.

The only embryological defects to which the cells of the thyroglossal strand itself give rise are the aberrantly placed nodules of thyroid tissue which are seen occasionally. These may arise at any point along the course of the thyroglossal tract from the base of the tongue to the lower part of the neck. Lateral aberrant thyroids similarly arise from the anlagen of the lateral thyroid lobes.

Pathology: Like the branchial cysts and fistulae described in Part I, the midline cysts and fistulae are lined with epithelium which may vary in structure from stratified squamous to ciliated columnar. The underlying tissue consists of fibrous tissue which may or may not be infiltrated with lymphoid elements. Microscopically it is impossible to distinguish the cysts and sinuses occurring in the midline from those arising on the lateral aspects of the neck.

Midline cysts and sinuses, like those on the lateral aspects of the neck, are subject to infection; this probably is often due to the lymphatic drainage of the upper respiratory passages into the lymphoid tissue which surrounds them. No case of tuberculous infection of a thyroglossal cyst or sinus has come to our attention.

Clute and Cattell[6] have described the only case of adenocarcinoma arising from the thyroglossal tract that has been reported in the literature. These authors feel that the rare cases of epidermoid carcinoma of the thyroid gland probably arise from misplaced oral epithelium which is carried down by the thyroglossal tract.

The contents of midline cysts are similar to those of branchial cysts and both may contain cholesterin crystals.

Clinical Features: This study is based upon thirty-four operations for thyroglossal cysts and twenty-six for thyroglossal sinus which have been performed at the Cleveland Clinic.

The sex, age of the patients at the onset of symptoms and at the time of operation, as well as the duration of symptoms before any surgical procedure was instituted are summarized in Table I. As will be seen,

TABLE I

THYROGLOSSAL DISEASE

	Cyst (34 Cases)	Sinuses (26 cases)
Sex -Male	10 cases—29 per cent	10 cases—39 per cent
Female	24 cases—71 per cent	16 cases—61 per cent
Age at onset		
Average	32 years	13.6 years
Present at birth	1 case	1 case
Eldest at onset	60 years	67 years
Age when first seen		
Average	34.7 years	21 years
Youngest	5 years	6 years
Eldest	65 years	68 years
Duration of symptoms		
Before First Operation	3.1 years	3.1 years

females predominate over males in a proportion of 2 to 1. This is to be compared with an incidence of 7 to 1 for females in diseases of the thyroid gland.[6] Thyroglossal sinus occurs at a considerably younger age than does thyroglossal cyst, 13.6 years being the average age of onset of the former and 32 years of the latter. The extremes of age at the time of onset are approximately the same, one patient in each group giving a history that the anomaly was present at birth. The duration of symptoms from onset until operation was the same in each case, 3.1 years.

Symptomatology: The patient with thyroglossal cyst comes for treatment because of a painless, usually slowly growing, tumor in the midline of the neck. In only rare instances does this tumor cause pain (four instances in the present series). The size of the tumor may vary from that which is just palpable to the size of a golf ball or even larger. In consistency, the cyst usually is firm or semifluctuant. Hoarseness and dysphagia are much less frequent symptoms than would be expected from the location of the tumor, the former occurring but once and the latter but three times in this series.

Patients with thyroglossal sinus are much more uncomfortable because of the persistent or recurrent drainage which soils the clothing and generally is unsightly. The majority of patients (73 per cent in this series) gave a history of a cyst which either had ruptured spontaneously or had been drained surgically. Very often spontaneous

rupture is a result of acute infection of the lining of the cyst, often coming on after an infection of the upper respiratory tract. It bears repeated emphasis that surgical drainage with or without the presence of acute infection always results in a chronically draining sinus.

TABLE II

LOCATION OF MIDLINE CYSTS AND FISTULAE

Location	Cyst	Sinus (External opening)	Total Cases	Per cent
Submental	1	2	3	5.0
Between hyoid and thyroid cartilage	18	8	26	43.3
Level of thyroid cartilage	6	8	14	23.3
Level of cricoid cartilage	2	3	5	8.3
Level of isthmus of thyroid gland	3	1	4	6.6
Suprasternal notch	2	0	2	3.3
Level not stated	2	4	6	10.0

Table II presents a summary of the location of midline cysts and fistulae. Two-thirds occurred between the hyoid bone and the lower border of the thyroid cartilage.

Diagnosis: The fact that thyroglossal sinuses occur in the midline, that the patients give a typical history of a preceding cyst which had ruptured spontaneously or been surgically drained combined with the fact that the sinus tract can be felt to extend from the external orifice to the hyoid region and can be felt to move with deglutition makes the diagnosis comparatively easy. Rarely (in two instances in this series), the cyst will be opened not at its lowermost midline portion, but away from the midline. This, of course, makes the point of drainage lateral to the midline and may lead to confusion in the diagnosis. However, the sinus tract always leads to the region of the hyoid bone and usually the major part of its course can be felt. The sinus tract moves with deglutition regardless of the location of the external opening. These points serve to distinguish it from tuberculous sinus which rarely opens in the midline.

Thyroglossal cysts present a somewhat more perplexing diagnostic problem. They may be distinguished from the midline adenomas of the thyroid by the difference in consistency and by aspiration of the contents of the cyst. Confusion with discrete, midline, tuberculous glands has been reported in a few instances. Dermoids are not easily differentiated, but these and wens are less likely to move with deglutition.

Treatment: The treatment of midline cysts and sinuses of the neck consists of the complete extirpation of all epithelial-bearing tissue.

In order to accomplish this it is necessary to remove not only the cyst or sinus tract below the level of the hyoid bone, but also that portion which extends from the center of the hyoid up to the foramen caecum. In order to accomplish this latter and most important step in the operation, it is necessary to split or resect the central portion of the body of the hyoid. The tract per se usually cannot be traced above this point, but must be removed by coning out the surrounding tissue for a distance of 0.3 cm. on each side up to the foramen caecum. In performing this dissection it is necessary to keep clearly in mind the direction the thyroglossal tract takes in its course from the hyoid to the foramen caecum. Sistrunk[7] has pointed out that this corresponds to a line drawn at an angle of 45 degrees posteriorly and superiorly through the right angle intersection of lines drawn horizontally and perpendicularly to the superior central portion of the hyoid bone.

Results of Treatment: Of the thirty-four patients with thyroglossal cyst who have been operated upon at the Cleveland Clinic, previous excision of the cyst had been performed elsewhere in three instances. In each case the cyst recurred and the hyoid was resected in none. Simple incision and drainage was done elsewhere in one instance.

Excision of the cyst was performed in thirty-three of the thirty-four cases and one simple incision and drainage was done for acute infection. Of the thirty-three cases in which excision was done, a portion of the hyoid was resected and the dissection carried up to the foramen caecum in seventeen. In two additional cases, the hyoid was split in the midline, the dissection was carried up to the foramen caecum, and the hyoid was resutured without the removal of a portion of its center. In fourteen cases the dissection was not carried through or above the hyoid. A satisfactory follow-up was obtained in twenty of the thirty-three cases in which excision was done. The average time of follow-up was 5.4 years, the extremes varying from 1 to 10 years. The cyst recurred in only one case, this being one in which the hyoid was not resected and in which the dissection was not carried up to the foramen caecum, while in none of the cases in which this procedure was carried out was there a recurrence. This serves to illustrate again the adequacy of the Sistrunk[7] operation and the inadequacy of any lesser procedure.

Of the twenty-six patients with thyroglossal sinus, who have been operated upon at this clinic, fifteen (58 per cent) had been operated upon previously. Of these fifteen cases, excision of the sinus tract or of a proceding midline cervical cyst had been performed in seven instances. At operation there was no evidence in any of these that the hyoid bone had been divided or excised in its midportion. Simple incision and drainage of a preceding cyst had been done elsewhere in seven cases and repeated incision and drainage plus an unsuccessful

attempt at excision had been used in one case. One patient gave an unusual history of the complete absence of symptoms for a period of fifteen years following simple incision and drainage of a noninfected cyst. These figures again speak for the necessity of doing the complete operation in every case.

Of the twenty-six operations performed for thyroglossal sinus sixteen were complete; in nine the dissection was not carried above the hyoid, and in one the treatment of the hyoid was not described. A satisfactory follow-up was obtained from twelve patients, the time of follow-up varying from 1 to 10 years (average 4.3 years). In none of these has there been a recurrence. In ten of the twelve cases followed, the hyoid bone was divided or excised in its midportion and the thyroglossal tract dissected out in its entirety up to the foramen caecum.

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THE FRANK E. BUNTS EDUCATIONAL INSTITUTE

As announced in the July issue of the Quarterly, The Frank E. Bunts Educational Institute will offer a graduate review course in "Diseases of the Kidneys and Genito-Urinary Tract" on Monday, Tuesday, and Wednesday, October 26, 27 and 28, 1936.

A complete outline of the course and application blank will be found on succeeding pages of this Quarterly.

DISEASES OF THE KIDNEYS AND THE GENITO-URINARY TRACT

Monday, October 26, 1936

8:30 A. M.	Registration	
9:00 A. M.– 9:05 A. M.	Introduction	Dr. W. E. Lower
9:05 A. M.– 9:45 A. M.	Clinical and Comparative Value of Renal Function Tests	Dr. R. H. McDonald
9:45 A. M.–10:15 A. M.	Significance of the Eye Examination in Genito-Urinary Lesions	Dr. A. D. Ruedemann
10:15 A. M.–10:55 A. M.	Diagnosis and Treatment of Infections of the Kidney and Bladder	Dr. C. C. Higgins
10:55 A. M.–12:00 Noon	Surgical Lesions of the Kidney and Their Management	Dr. W. E. Lower
12:00 Noon– 1:00 P. M.	Luncheon	
1:00 P. M.– 2:00 P. M.	Demonstration of Laboratory Procedures of Importance in Urology	Mr. Alfred Reich
2:00 P. M.– 2:40 P. M.	Urological Conditions in Children	Dr. W. J. Engel
2:40 P. M.– 3:40 P. M.	Differential Diagnosis from the X-ray Standpoint of Lesions of the Kidney	Dr. B. H. Nichols
3:40 P. M.– 4:30 P. M.	Renal Calculi: Their Diagnosis and Treatment Including Dietary Regimen	Dr. C. C. Higgins
4:30 P. M.– 5:00 P. M.	Special Points in the Pre- and Post-operative Management of Urological Patients	Dr. W. I. Buchert
6:00 P. M.	Dinner	
8:00 P. M.	Frank E. Bunts Lecture: Functional Disturbances Arising from Impediments to Urination — Urethral or Ureteral	Dr. E. L. Keyes, Professor of Clinical Surgery, Cornell University Medical College.

Tuesday, October 27, 1936

9:00 A. M.–10:00 A. M.	Roentgen Diagnosis of Lesions of the Ureter and Bladder	Dr. B. H. Nichols
10:00 A. M.–10:30 A. M.	Management of Lesions of the Ureter, Including Surgical Procedures	Dr. W. E. Lower

Tuesday, October 27, 1936—Continued

DISEASES OF THE KIDNEYS AND THE GENITO-URINARY TRACT

10:30 A. M.–11:30 A. M.	Diagnosis and Treatment of Acute Primary Syphilis and Chancroids	Dr. E. W. Netherton
11:30 A. M.–12:00 Noon	The Heart in Relation to Anesthesia and Urological Surgery	Dr. A. C. Ernstene
12:00 Noon– 1:00 P. M.	Luncheon:	
1:00 P. M.– 2:30 P. M.	Research Demonstration: Friedman Tests; Male Sex Hormones; Transplantation of Ureters into the Rectosigmoid; Experimental Production and Solution of Urinary Calculi; Observations on Prostatic Hypertrophy.	
2:30 P. M.– 3:00 P. M.	Demonstration of Instruments and Indications for the Use of Each in Genito-Urinary Practice. Demonstration of Placing of Inlying Catheters	Dr. W. E. Lower and Mr. E. Rogers
3:00 P. M.– 4:00 P. M.	Diagnosis and Treatment of Late Cutaneous and Mucocutaneous Syphilis	Dr. E. W. Netherton
4:00 P. M.– 5:00 P. M.	Clinical Endocrinology of the Testes, Including Hypogonadism (Sterility and Impotence) and Cryptorchidism	Dr. E. P. McCullagh
6:00 P. M.	Dinner	
8:00 P. M.	Frank E. Bunts Lecture: Radiological Aspects in the Treatment of Malignancies of the Genito-Urinary System	Dr. Francis Carter Wood, Professor of Cancer Research, Columbia University College of Physicians and Surgeons.

Wednesday, October 28, 1936

9:00 A. M.– 9:40 A. M.	Management of Tumors of the Bladder	Dr. W. J. Engel
9:40 A. M.–10:30 A. M.	Gastro-Intestinal Symptoms of Lesions of the Genito-Urinary Tract	Dr. C. L. Hartsock
10:30 A. M.–11:00 A. M.	The Rôle of Sterility in the Female. Technic of Tubal Inflation	Dr. T. E. Jones
11:00 A. M.–12:00 Noon	Differential Diagnosis and Treatment of Lesions in the Scrotum and Testicles (Tumors, Epididymitis, Hydrocele, Spermatocele)	Dr. C. C. Higgins
12:00 Noon– 1:00 P. M.	Luncheon	
1:00 P. M.– 2:00 P. M.	Dry Clinics	
2:00 P. M.– 2:30 P. M.	Roentgen Diagnosis of Renal Tuberculosis	Dr. B. H. Nichols
2:30 P. M.– 3:00 P. M.	Management of Patients with Renal Tuberculosis	Dr. C. C. Higgins

Wednesday, October 28, 1936—Continued

DISEASES OF THE KIDNEYS AND THE GENITO-URINARY TRACT

3:00 P. M.– 3:40 P. M.	Bladder Lesions of Neurological Origin	Dr. W. J. Gardner
3:40 P. M.– 4:10 P. M.	Treatment of Bladder Neck Obstruction by Transurethral Resection	Dr. W. J. Engel
4:10 P. M. –5:00 P. M.	Management of Patients with Prostatic Hypertrophy. (Prostatectomy and Medical Management with Contruin Therapy)	Dr. W. E. Lower

Surgical Clinics Will Be Held Thursday, October 29.

EXHIBITS

Experimental Production and Solution of Urinary Calculi.
Surgical Management of Urinary Calculi.
Wax Models of Surgical Specimens.
Transplantation of Ureters into Rectosigmoid.
Photometer Test for Determination of Vitamin A Deficiency.
Roentgenograms of Renal Neoplasms.
Sex Hormones Studies.
Experimental Study of Prostatic Hypertrophy.

REGISTRATION BLANK

_____, 1936

The Frank E. Bunts Educational Institute,
Cleveland Clinic
Cleveland, Ohio

Gentlemen:

Please register me for the Graduate Review Course in "Diseases of the Kidneys and Genito-Urinary Tract," which is to be given October 26, 27 and 28, 1936.

I am enclosing a check for $5.00 and the remainder of the fee, $5.00, will be paid on registration, October 26th.

Name_____

Address_____

_____
Medical School From Which Graduated

Note: Checks should be made payable to The Frank E. Bunts Educational Institute and sent to A. D. Ruedemann, M. D., Cleveland Clinic, Cleveland, Ohio.

THE FRANK E. BUNTS EDUCATIONAL INSTITUTE

The Frank E. Bunts Educational Institute, in conjunction with the Cleveland Ophthalmological Society, announces a graduate review course in Ophthalmology on December 7, 8, and 9, 1936.

On December 10, 11, and 12, a graduate review course will be given in Diseases of the Ear, Nose, and Throat.

The fee for the two courses will be $25.00 or if only one course is taken, it will be $15.00.

Further information and application blanks may be secured from A. D. Ruedemann, M. D., Cleveland Clinic, Cleveland, Ohio.

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